MARINE TECHNOLOGY REPORTER

June 2019

www.marinetechnologynews.com

Hydrographic Survey

OSVs are ready for faster sensors

USVs

MUMs (& Daughters) of Invention

Research Institutions

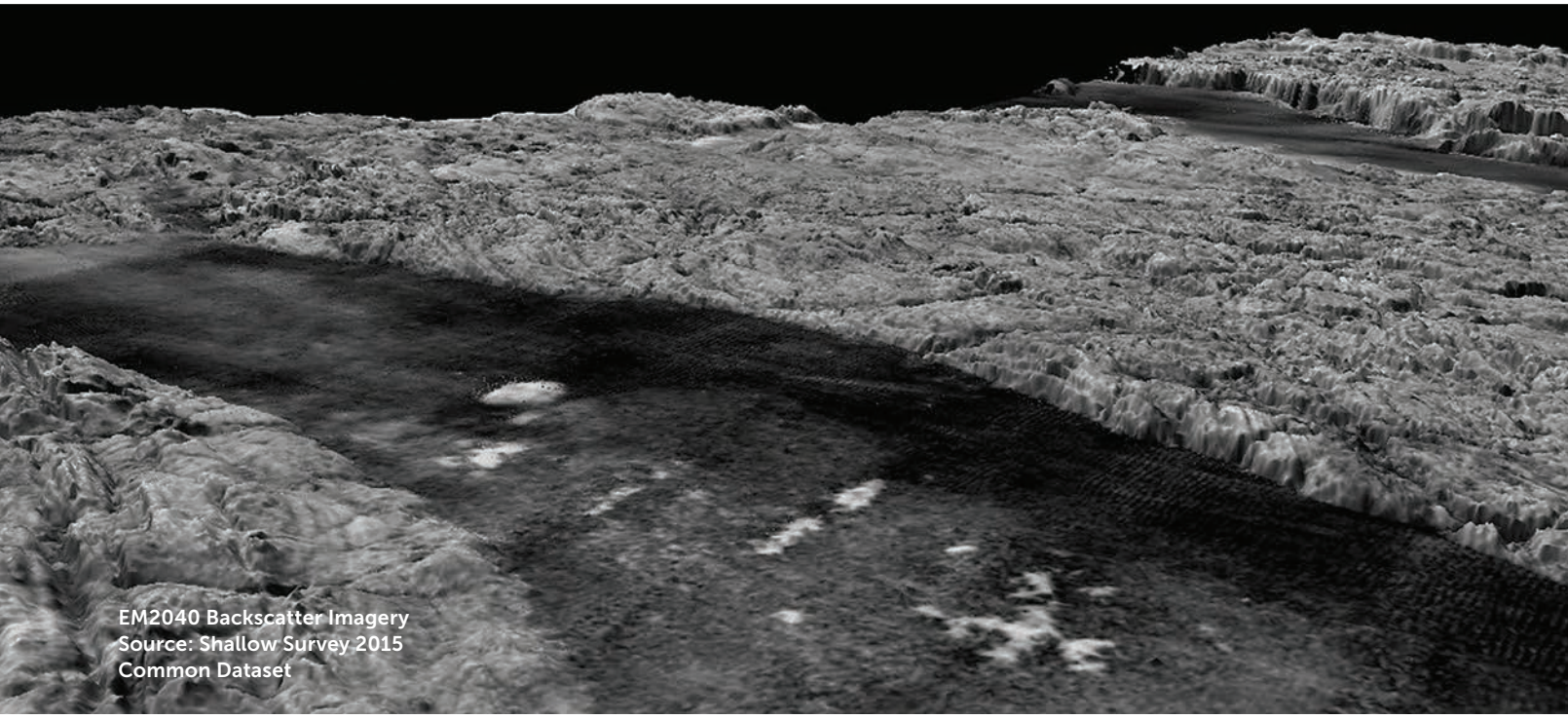
Automating Environmental Monitoring

Offshore Energy

Offshore Wind's One-Stop Power Conversion

Volume 62 Number 5

AUTOMATION FOR BACKSCATTER PROCESSING



EM2040 Backscatter Imagery
Source: Shallow Survey 2015
Common Dataset

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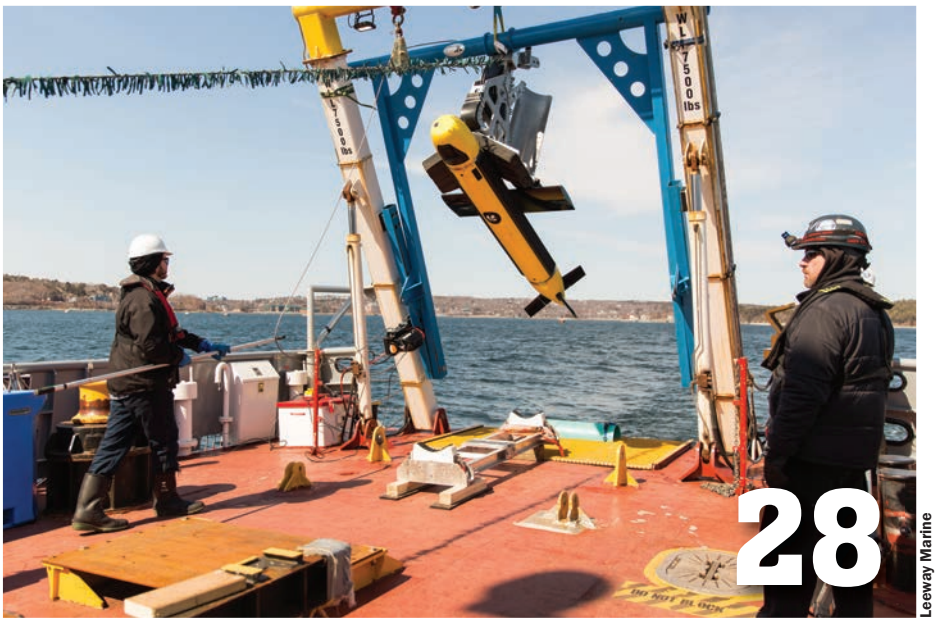
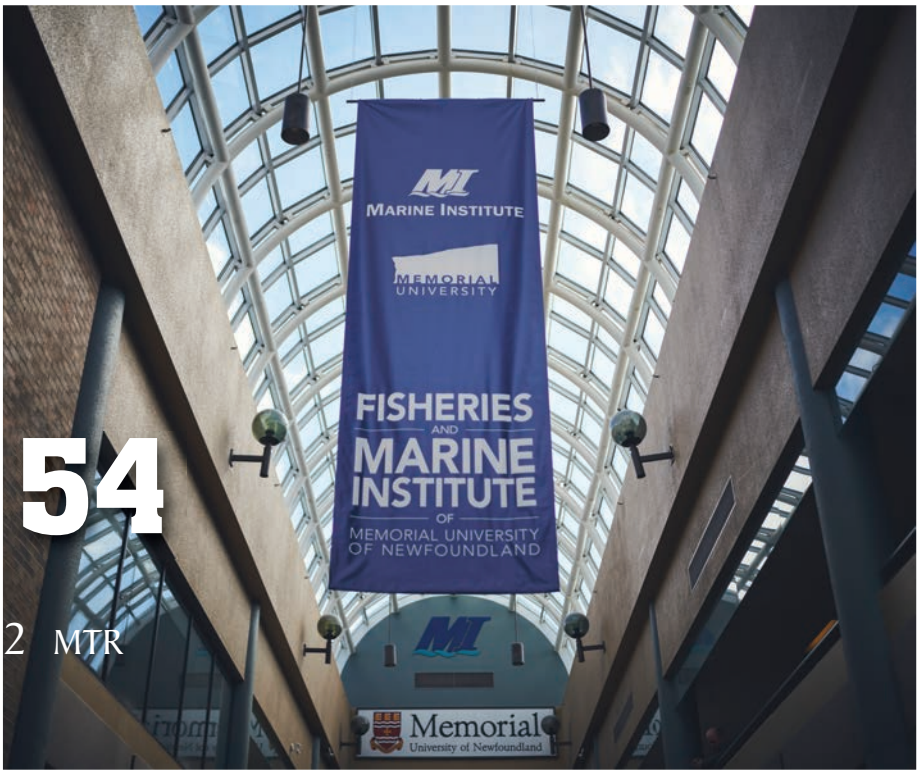


Leeway Marine



Fisheries and Marine Institute of Memorial University of Newfoundland

Vehicles

Hydrographic Survey

Offshore Renewable Energy

Research Institutions

Qinertia

The Next-generation INS/GNSS Post-processing Software

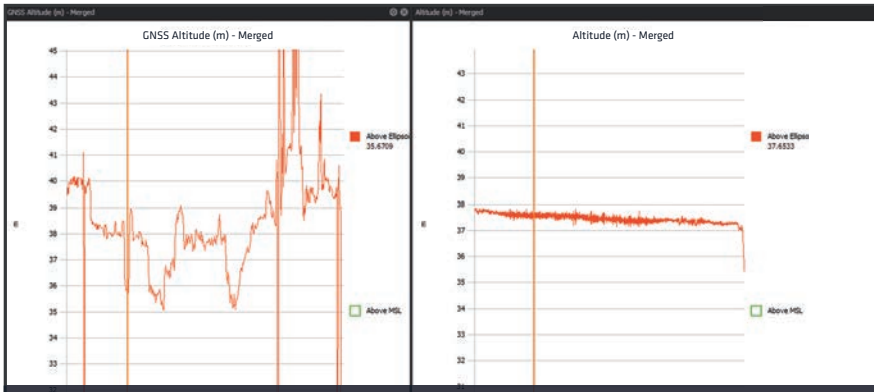
Quality: *Green -> centimetric position; Blue -> decimetric < 30cms; Red -> Raw GNSS data*

SURVEYING UNDER BRIDGES MADE EASY

This survey has been done with an APOGEE INS under very challenging conditions for the GNSS receiver (red dots).

The boat is crossing multiple times three large bridges including one made of steel.

With Qinertia and its unique 100% in-house GNSS/INS tightly coupled forward / backward processing, data collected under the bridges are fully exploitable (blue / green trajectory).



Altitude – Left GNSS only, Right: Post-processed

The Fastest PPK Software

Log duration: 2h15
Processing Time: < 2 mins

Long GNSS Outages Handling

Example: up to 80 seconds *outages and multi-path effects*
95% positions < 2 cms
Max error < 30 cms

Easy & Powerful Exporter

Easy export to third party software (SBET/ ASCII)

Many thanks to Hydro Systems Development (HSD Japan) for their kind collaboration.

Full data available upon request at marketing@sbg-systems.com
www.sbg-systems.com

SBG SYSTEMS

LeeWay Marine

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Editor's Note

The need for speed

As anyone reading these pages can attest, the ability to work safely, efficiently and quickly under water is one of the greatest challenges of any of the world's industries. I've read, written and said it so many times that it's begun to feel trite, but there are few environments on the planet that are as hostile, corrosive and fast-evolving as earth's bodies of water. It is a true testament to the collective innovative spirit of the subsea community, from the scientists to the companies, large and small, as well as those in government and military, that the technological revolution has evolved at pace. Simultaneously, there has been increased interest in and pressure to clean up the ocean environment. From plastics to pollution, from underwater noise to strains on the fish population, working in our waterways efficiently is a foundation to many pillars in the world economy, from energy to food to international commerce.

For these reasons I am particularly pleased to share our cover story this month, by Jamie Sangster, CEO of LeeWay Marine, presenting his take on what is needed to drive the industry further, faster. His article "The Game has Changed" addresses the need for faster sensors, and starts on page 28.

Much of the technology we profile in print and online has its roots in one or more of the world's research institutions. Starting on page 48 you will find recent research from three leading institutions, from Italy to Miami to Newfoundland.

Gregory R. Trauthwein
Associate Publisher & Editor

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Maslin

Elaine Maslin is an offshore upstream and renewables focused journalist, based in Scotland, covering technologies, from well intervention and asset integrity to subsea robotics and wave energy.

Mulligan

Tom Mulligan graducated from Trinity College Dublin in 1979, with a BA Hons Degree in Natural Sciences (Chemistry). In 1986 he obtained a Masters Degree in Industrial Chemistry in 1988. Today he is Marine Technology Reporters science and technology writer based in Dublin.

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Jamie Sangster is the founder of Leeway Marine. Prior to Leeway, Jamie served in the Royal Canadian Navy for 20 years as a marine systems engineering officer and naval architect, and has extensive sea experience aboard Canadian major warships.

Stoichevski

William Stoichevski is an Oslo-based journalist reporting on maritime and offshore energy topics for multiple New Wave Media titles, including Marine Technology Reporter, Maritime Reporter & Engineering News and Offshore Engineer.

Deep down in the Indian Ocean

Teledyne Marine delivers solutions for NEKTON'S First Descent mission

Undoubtedly, the most visual Teledyne product used on NEKTON's First Descent mission to explore the little-known Indian Ocean is a Teledyne Bowtech underwater camera. The new Surveyor-HD-Pro ultra-wide underwater HD camera has been designed to provide the widest angle of view, while remaining compact and competitively priced. The stunning images collected from this recent expedition using this camera speak for themselves, providing amazing clarity and field of view.

To learn more about Teledyne Bowtech's camera and light solutions, visit: www.teledynemarine.com/bowtech

To learn more about Nekton's First Descent, visit: www.nektonmission.org

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Subsea Visualization: "You never miss anything"

At the Offshore Technology Conference 2019 (OTC) in Houston this year Sidus Solutions and Vantrix unveiled a partnership which aims to design and deliver a new subsea camera with some unique and unparalleled capabilities. "You never miss anything," is how Leonard Pool, Managing Director of Sidus Solutions, described the system, which offers a 182-degree field of vision and the ability to allow multiple users in multiple locations to see unique views from the same camera, simultaneously.

Pictured are (L to R): Leonard Pool, Sidus Solutions, Mark Hopper, VP, and Francis Labonte, both with Montreal-based Vantrix.

WFS Smart Waters - Smart Cities

WFS Launches Subsea Wireless Edge Network

WFS Technologies Limited (WFS) unveiled what it claims is the world's first subsea wireless edge network for real-time monitoring of subsea assets. ExtremeEdge was developed to process and analyze the raw data at the sensor level, thus reducing information overheads by transmitting only the data needed to downstream solutions in real-time rather than all sensor data collected. In addition, by deploying a number of ExtremeEdge-enabled sensors, WFS has created the first subsea network designed to operate wirelessly. Traditionally, most solutions operate by individual sensor only, and not as a network of sensors that can communicate, process and transmit data between themselves, increasing subsea asset monitoring efficiencies. Each new Seatooth sensor, using a patented wireless technology standard for exchanging data through water and the water-air boundary using low frequency radio waves, is supplied with a built-in processor with the capability to run WFS ExtremeEdge computing.

Photo credit: D. Chadwell, Scripps Institute of Oceanography (Webb/Chadwell/Nooner US NSF GeoPRISMS project)

Image Courtesy Sercel

Sonardyne Tech for Seabed Observatory

A new seabed observatory is to be deployed offshore Vancouver, Canada, using long endurance acoustic sensing technology supplied by Sonardyne. The new Northern Cascadia Subduction Zone Observatory (NCSZO) will use a "seafloor GPS" network to monitor long-term movements of the subducting Juan de Fuca plate and overriding North American tectonic plate. Data gathered by the new observatory will play a critical role in informing assessments of earthquake and tsunami risk to the large populations of the Pacific North-West. More than 20 Sonardyne Fetch subsea sensor logging nodes, which will be deployed in depths ranging from 400 to 2,500 meters of water depth for seven years or longer at a time, will comprise the backbone of the NCSZO. Data will be acquired up to two times a year using a technique called GPS-Acoustic method (GPS-A), the commercial application of which has been pioneered by Sonardyne. GPS-A uses acoustic positioning techniques, inertial navigation, and GPS data to periodically position the Fetch instruments to centimetre-level accuracy, using a Sonardyne transceiver mounted on an unmanned surface vessel.

Sercel's QuietSea Marine Mammal Monitoring System

Sercel announced the deployment of its QuietSea Passive Acoustic Monitoring (PAM) system has been extended to the UK, following approval by the UK Department for Business, Energy & Industrial Strategy (BEIS) and Joint Nature Conservation Committee (JNCC) of its use for a seismic survey operated by CGG in waters off the Shetland Islands. The sensors are designed to fully integrate with seismic acquisition or navigation systems, and are incorporated with the hydrophones in the Sentinel streamer.

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Getting Down to It:

50 Years of Subsea Success in Norway

The Norwegian Continental Shelf's journey from the very first basic marinized subsea trees to today's complex and sophisticated subsea processing equipment has been a rapid, at times turbulent, but always remarkable.

There are many engineers who have seen through that journey, from the first exploration wells using Norwegian rigs in the mid-1970s to today. One has now written the history of subsea technology in Norway and this year's Underwater Technology Conference (UTC) has been chosen for its launch, as the event itself marks its 25th anniversary.

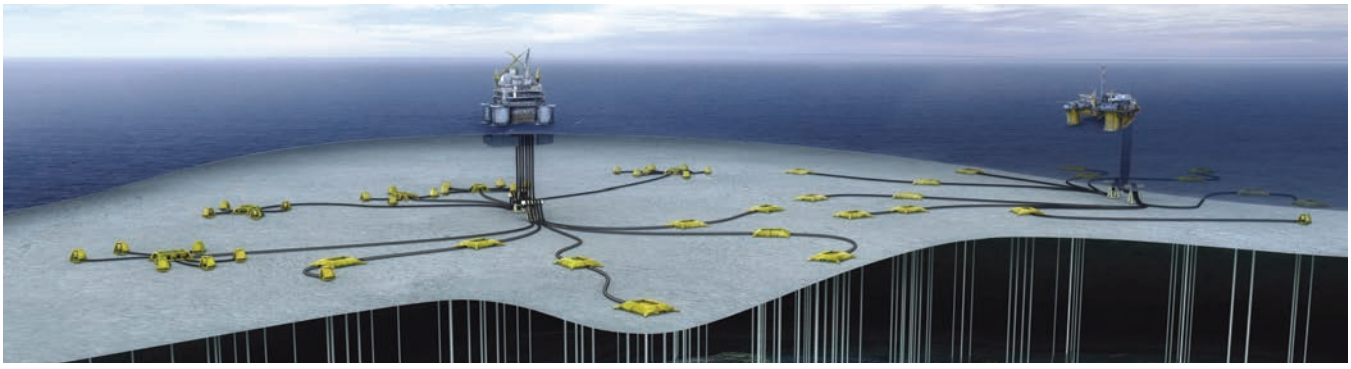
Getting Down to It; 50 Years of Subsea Success in Norway has been co-authored by industry veteran, and now professor emeritus at the University of Stavanger (UiS), Arnfinn Nergaard, and senior historian at the Norwegian Petroleum Museum Kristin Øye Gjerde.

Nergaard was perhaps destined for a career involving the sea, having been born and raised on the island of Smøla not far from the Haltenbanken. His original career choice was naval architecture. However, after completing his degree at the Norwegian University of Science and Technology (NTNU), or NTU (the Norwegian Institute of Technology) as it was in 1972, he saw the emergence of a new industry, petroleum exploration, and went on to complete an MSc and then a PhD in petroleum technology and applied geophysics, also at NTNU. In fact, he's the first Norwegian to have completed a PhD in the subject in Norway.

The timing was fortuitous. He joined Norske Hydro in 1975, the same year that the company, Saga Petroleum and Statoil were drilling their first wells on the Norwegian Continental Shelf (NCS) using Norwegian rigs. Field developments on a huge scale and new technologies came fast. "I was on the North East Frigg project with Elf when the first subsea completions were installed in Norway in 1979," says Nergaard. "At that time, it was very advanced; we had subsea Xmas trees. They were land trees that were marinized and there was nothing sophisticated about them, simply valves that opened and closed. Today, we have seen Equinor install two giant compressors on the seabed. The difference between those two technologies is enormous." Indeed, the industry has come a long way.

Nergaard and Gjerde's book charts the rise of the industry, starting with the award of the first exploration licenses in 1965, and the discovery of Ekofisk in 1969, using Norway's first subsea wells, derived then from technology imported from the USA. The book then goes on to look at how tragedies, deaths of divers, showed the need to find alternative technologies that put humans out of harm's way; the influence of French fascination for new technologies in the 1980s; how Norwegian operators have driven the development of ever growing subsea systems; 1990s' standardization; and, reflecting today's world, previous rounds of consolidation in the market.

The idea for the book came about six years ago. A group of industry veterans met and went to the director of the oil museum in Stavanger with an idea for a book, outlining the history of Norwegian subsea technology. Nergaard, who was still an active professor at UiS at the time, was elected to be in a reference



Norwegian Petroleum Museum

group. He then retired from UiS and, not long after, received a call. "The director told me they had found an author. And that was me. That was three years ago," recalls Nergaard. "I've always been interested in history and this is a history I have been involved in from the start, so I really wanted to do it." He's worked on the book over the last two and a half years with Gjerde, who has also co-authored a book on the history of Norwegian diving and the pioneer divers; On the edge, under water: offshore diving in Norway.

Research and writing the book has given Nergaard chance to reflect. "I've been involved in many projects over all of these years, but, to see all the things that I wasn't involved in was quite amazing seeing how many innovations there were all the time, technologically," he says. "A lot of people, inventor had some success, some didn't.

"Also, throughout the crises that we have had over the years, some companies have disappeared and some stood up and became billion NOK companies that were not so much worth anything at one time. There's been a lot of cost for people involved; it's an extreme sport."

Norway's success in subsea technology has been driven by a number of factors. The Norwegian government very much pushed new technology, says Nergaard. There was also strong competition among the Norwegian players to come up with the best solutions – a thirst which has continued through the decades. A 2012 Quest Offshore survey of who put the most effort into subsea technology development put Statoil (now Equinor) in top place (against international super majors), with double the number of projects of the company in second place, says Nergaard. And there was support for Norwegian companies. So, while some of the core technology came from Houston, it was adapted, developed and evolved into new solutions provided by Norwegian companies.

Recording this history is important, not least because it celebrates this remarkable industrial achievement, says Nergaard, building not only an industry but a global export business, while trying to make the industry safer. It's also close to the hearts of many people who have been involved in the industry over the last five decades.

While there's a lot to celebrate about Norway's remarkable technological and industrial journey over the last 50 years, there are challenges facing the industry today, however. "We have a challenge in industry in general with environmental issues," says Nergaard. "I think that our society is still very dependent on energy. Our challenge is to continue our developments and to maintain it with a lower environmental footprint than we have

Norwegian Petroleum Museum

Getting Down to It; 50 Years of Subsea Success in Norway **has been co-authored by industry veteran, and now professor emeritus at the University of Stavanger (UiS), Arnfinn Nergaard, and senior historian at the Norwegian Petroleum Museum Kristin Øye Gjerde.**

now. I have been in the industry a long time and I remember when we didn't discuss environmental issues at all. We're not alone. On a political level, we now need to integrate our industry with political decisions."

There's also a challenge to attract new talent. But this is a challenge the industry has faced repeatedly.

"The challenge is that this industry has always been a bit of a roller coaster when it comes to crises and the ups and downs, the difference between the bonanzas and the troughs is tremendous," says Nergaard, "and the oil companies don't really take responsibility to see that we have continuity during the crises. And that's really a disappointment. It seems like the industry has a memory of something like five years. As long as things are going well, it makes a good effort to recruit. In the last four years, it's disappointing to see they are closing their programmes, just to see that they have to be taken up again."

Still, the industry is still strong on the west coast and people are more aware of the opportunities, he says. UTC Bergen is also doing its bit, with a Young programme running through this year's event.

Nergaard has enjoyed his most recent challenge, so much so, he thinks there's potential for another book, this time on the Norwegian rig industry; another fascinating tale.

Getting Down to It; 50 Years of Subsea Success in Norway will be launched at UTC Bergen in Norwegian and in English on June 12.

UTC 2019 is June 11-13. The event is co-hosted by the Underwater Technology Foundation (UTF) and GCE Ocean Technology, supported by the City of Bergen, with organising partners the Society of Petroleum Engineering (SPE) and the Society of Underwater technology (SUT).

To find out more about this year's program, visit:

https://www.utc.no/program

Great Barrier Reef's 3D Habitat

The mapping project, '3D live habitats for the full extent of the Great Barrier Reef,' will provide maps of the predicted coral types and underwater landscape for the more than 3,000 reefs within the 350,000 sq. km of the GBR.

EOMAP's technology provides essential data for this world-first project, in which the University of Queensland (UQ), Great Barrier Reef Marine Park Authority, and the Australian Institute of Marine Science are partners.

The resulting maps will be at an unprecedented 10m horizontal grid resolution and reveal bathymetry (water depth), geomorphic zones and bottom types, in addition to the predicted coral types.

"No maps exist to date that provide so much detail for every single reef," says project leader, Dr. Chris Roelfsema from the Remote Sensing Research Centre at UQ.

He said that a lack of detail in existing maps is an ongoing issue in environmental science. "To understand and protect an environment you need to know the highest level of detail," he says. "It's like managing your budget—if you don't know exactly how much you have, then how do you know what to do?" The ambitious scope of this undertaking was made possible by recent advances in satellite-mapping technologies, environmental modelling and image classification methods.

Using the European Space Agency Sentinel-2 platform satellite imagery, EOMAP applies its industry leading, proprietary technology to retrieve satellite-derived bathymetry (SDB) and sub-surface reflectance (SSR).

The result of the SDB mapping is a 3D elevation model of the seafloor—one of the cornerstone data layers for the entire project.

"Accurately mapping bathymetry using satellite imagery requires very sophisticated, physics-based algorithms," said Dr. Magnus Wettle, Managing Director of EOMAP Australia.

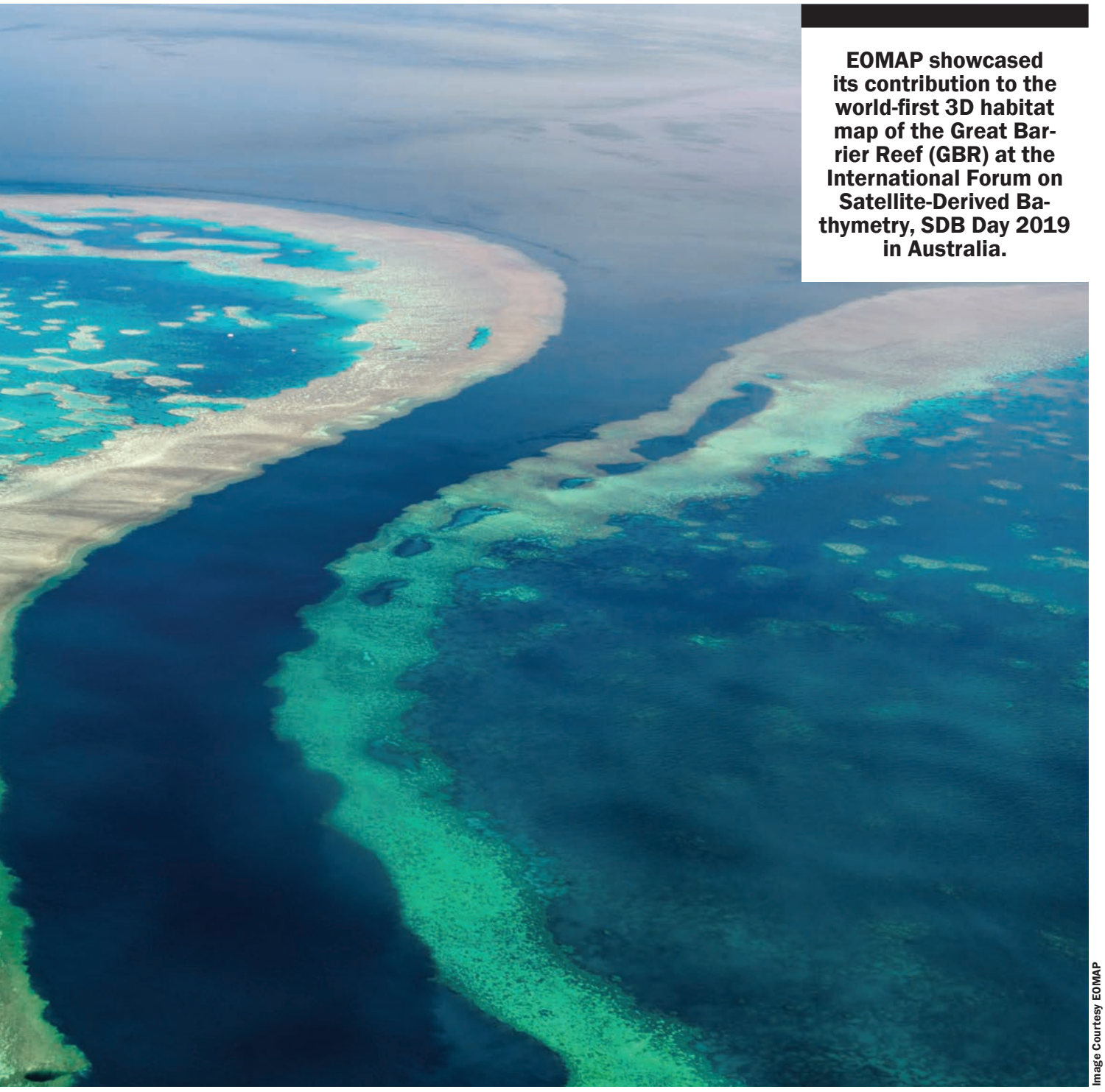
"Our algorithms are able to account for the path of sunlight as it travels down through the atmosphere, through the water column, reflects off the seafloor and back up to the earth-orbiting satellite sensor."

Both the SDB and the SSR data are fundamental to the overall project. The SDB not only directly guides the geomorphology classification but is also used for environmental modelling input to calculate wave energy environments across the GBR. The wave energy parameter in turn informs all reef habitat classification and predicted coral types.

The SSR data provides marine ecologists with additional, important information, when revealing the theoretical sea-

floor color for the final habitat classification. Recent advances in machine learning and semi-automated classification then enable the researchers to efficiently and accurately process and classify all the reefs of the GBR.

"The importance of the outcomes from this project cannot be overestimated," adds Dr. Thomas Heege, CEO of EOMAP. "As an example, to monitor coral bleaching over the entire Reef—a serious concern given recent events—you first need to know if you are looking at bleached coral habitat or at bright, reflective sediment. The 3D live habitat map gives you this baseline environmental information, correctly geo-positioned, to within 10 meters."



EOMAP showcased its contribution to the world-first 3D habitat map of the Great Barrier Reef (GBR) at the International Forum on Satellite-Derived Bathymetry, SDB Day 2019 in Australia.

Image Courtesy EOMAP

MarineNav ROVs for Marine Inspections

By Tom Mulligan

MarineNav, located in Montague, Prince Edward Island, Canada, has been showcasing its latest technologies and equipment serving defense, aquaculture, law enforcement and first responder needs in marine operations. The company's offerings include marine-grade navigation components such as computers and displays; advanced vessel monitoring (AVM) and fleet management systems; and customizable industrial underwater remotely operated vehicles (ROVs).

Interchangeable ROV components

For its ROVs, MarineNav has developed units that are designed to enable quick and easy exchange of interchangeable modular components. The company said that with a range of optional plug-in accessories available, its ROV design is rugged and versatile and that units can be operated by a single person, while interchangeable modules minimize ROV downtime, thereby reducing repair costs. The majority of the company's ROV components are manufactured in-house at its Montague premises.

MarineNav manufactures a number of ROV product types, including its Oceanus Hybrid ROV System, the Oceanus Hybrid Plus ROV System, the Oceanus Pro ROV System, and the Oceanus Pro Plus ROV System, each with its own particular features and operational advantages, plus a range of Oceanus ROV accessories. The Oceanus Ultimate ROV System will debut in the fall of this year.

Easy-to-use packages

The Oceanus Hybrid versions were developed as an inspection-class ROV system supplied as a basic and easy-to-use package. Capable of performing underwater search and recovery missions and environmental assessments, the Oceanus Hybrid is also well-suited for propeller, hull and wharf inspections, and, with a weight of only 39 lbs (17.7 kg), is esily operable by one person. The unit features a sunlight-readable, splash-resistant 12-inch (30 cm) display that en-

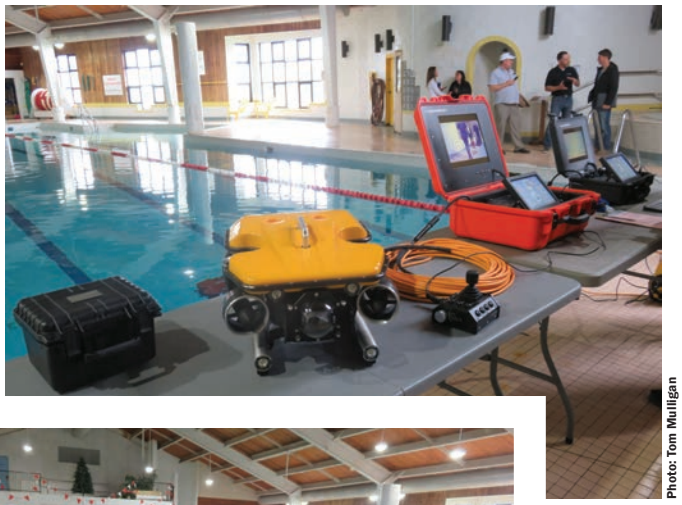


Photo: Tom Mulligan

The Oceanus Pro ROV from Canadian company MarineNav can be operated by just one person and is designed as a rugged inspection-class ROV capable of operating to a maximum depth of 1000 feet (305 meters) at a maximum speed of six knots for use in propeller, hull and wharf inspections and underwater search and recovery missions.

ables it to be used in any daylight conditions. Its control console is protected by a water-resistant case and the DC power input allows operation in situations where AC power is not available.

The Oceanus Hybrid Plus ROV offers all the features of the Oceanus Hybrid but with the added features of a large 15-inch (38 cm) TFT-active matrix panel on the Topside Control Case, as well as greater flexibility in the choice of attachments that can be added to the unit, thereby increasing functionality and the number of different tasks that the ROV can perform.

New product introductions

MarineNav's latest ROV product introductions are its Oceanus Pro and Oceanus Pro Plus ROV systems. These units are rugged inspection-class ROVs capable of operating to a maximum depth of 1000 feet (305 meters) at a maximum speed of six knots, making them highly suited for performing not only propeller, hull and wharf inspections but also for carrying out underwater search and recovery missions. The low weight of the Oceanus Pro and Oceanus Pro Plus submersibles of 38.1 lbs (17.3 kg) means that the units can be easily deployed by one person, while the standard features of these units include an ROV housing made of anodized aluminium and an ROV power tether. Optional upgrades include wireless broadcasting in which the operator can enable screen-sharing with other operatives and the MarineNav Fleet Management Suite – this reports the status and health of ROVs remotely to give full tracking of single or multiple units.

The Oceanus Pro Plus includes all the features of the Oceanus Pro as well as the flexibility to customize the system with a range of extra features and attachments, for example the upgrade of the Topside Control Case to an 18.5-inch (47 cm) widescreen version or a 24-inch (60 cm) TFT-active matrix LCD display.

The Oeanus Pro Plus is equipped with Full HD 1080P front and back cameras to enable simultaneous viewing and an optional 4K external camera provides even greater functionality.

GeoSpectrum

Specialist Acoustic Components

By Tom Mulligan

Dartmouth, Nova Scotia based acoustics specialist company GeoSpectrum Technologies Inc, a producer of underwater acoustic transducers and systems, has been in operation for more than 20 years, supplying hydrophones and sound projectors to a range of customers in the marine and oceanography sectors, as well as providing consultancy services on acoustic systems integration and test procedures. End-user sectors include defense and homeland security, oil & gas, and environmental services. As well as standard products, GeoSpectrum can also provide customized products and is particularly recognized as a leading provider of systems for the marine mammal monitoring and ocean observation sectors.

Components designed and manufactured by the company are tested with a range of on-site equipment to ensure these meet customer requirements: this equipment includes pressure and environmental chambers and NIST-traceable calibration equipment, and the company has a production facility capable of manufacturing more than 1000 hydrophones a day.

GeoSpectrum's wide-band omnidirectional hydrophones include an integral, low-noise voltage- or current-signalling preamplifier and can be configured to operate over customer-defined bandwidths with required sensitivity and also allow for customizable gain. In addition, the depth rating for each hydrophone can be tailored to meet specific requirements to meet shallow- to deep-water requirements.

Photo: GeoSpectrum Technologies.

Deployment of a C-BASS VLF sound projector: a recent product launch from GeoSpectrum Technologies that fulfils a range of operational roles for the marine sector.

In addition to hydrophones, the company designs and manufactures electrodynamic sound projectors and has recently introduced its C-BASS family of very-low-frequency projectors. These are less expensive and smaller, lighter and designed to be more efficient than standard products. With their broad bandwidth, they can be used in a variety of applications where sound projectors could not previously be employed. The C-BASS systems may be used omni-directionally or in arrays to produce high-power sources with or without directivity and applications include their use as diver deterrents to protect marine assets; as VLF ASW systems; as a VLF calibration source; in AUV-based target emulation; for underwater navigation/GPS applications by providing a network of beacons; for acoustic and health monitoring purposes; and in VLF communication systems with a range exceeding 1,000 km.

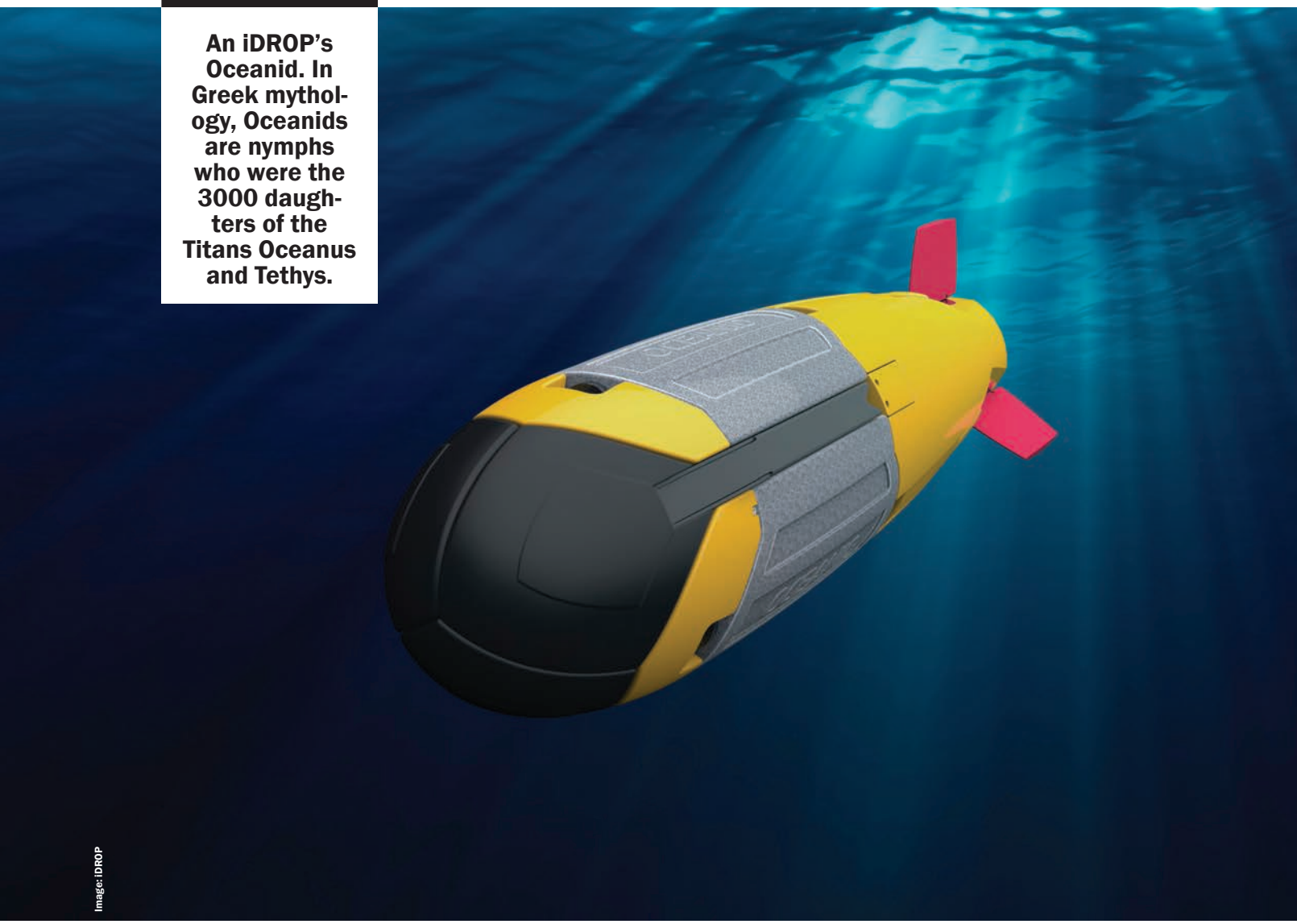
Photo: GeoSpectrum Technologies.

A GeoSpectrum Technologies C-BASS VLF sound projector undergoing underwater testing in a land-based test tank.

MUMs *(and daughters)* of invention

Sea nymphs and MUMs are inspiring a new generation of underwater systems and vehicles.

By Elaine Maslin



An iDROP's Oceanid. In Greek mythology, Oceanids are nymphs who were the 3000 daughters of the Titans Oceanus and Tethys.

Image: iDROP

The list of applicants to enter the underwater domain is growing fast. The concepts vary, from underwater autonomous motherships able to carry an array of payloads over long distances to swarms of drop deployed ocean bottom nodes that can find their way to pre-programmed locations.

At energy:connected, as the Oslo-based Subsea Valley cluster and annual conference is now called, some of these concepts were outlined, including those from two Norwegian technology firms and Germany's thyssenkrupp, a firm more used to designing naval submarine systems.

uSEA unveils uLARS

One, Norwegian technology start-up uSEA, is proposing a hybrid system to disrupt existing manned vessel supported subsea operations via a subsea and surface drone combination.

uSEA was founded in 2017 and since then it has been developing a surface drone, or unmanned surface vessel (USV), to support underwater drones (i.e. autonomous underwater vehicles or AUVs), so that manned vessels are no longer needed and battery recharging can be done in the water, avoiding launch and recovery operations. This makes it different to other surface drone concepts, which tend to rely on full recovery of the AUV or remote operated vehicle (ROV) for recharging. uSEA's system is called uLARS (LARS meaning launch and recovery system) for underwater drones, says uSEA CEO Felipe Lima, who served in the Brazilian Navy before working at Subsea 7, Aker Solutions and Xodus Group.

It's a natural progression. Today's AUVs are getting more and more capable and reliable, says Lima. "They are taking the space that has been the backyard of ROVs. But, they have a limitation; they rely on batteries, because they're not cabled like ROVs, and they still need a mothership, eg. a survey vessel, because their batteries run out in 12-48 hours. With a mobile docking station for the AUV, you're not reliant on a docking station on the seabed and you don't need a larger surface vessel."

The system includes a submersible towing head, with an inductive connector for charging and data transfer, which acts a little like an in-air refuelling of fighter jets. "This means there's minimal impact from waves because the docking is at a controlled depth," says Lima, who has an MSc in Subsea Engineering from University of Aberdeen and a MSc in Innovation and Entrepreneurship from University of Oslo. There's also a through moon pool-based handling system for recovering the AUV on deck, safely.

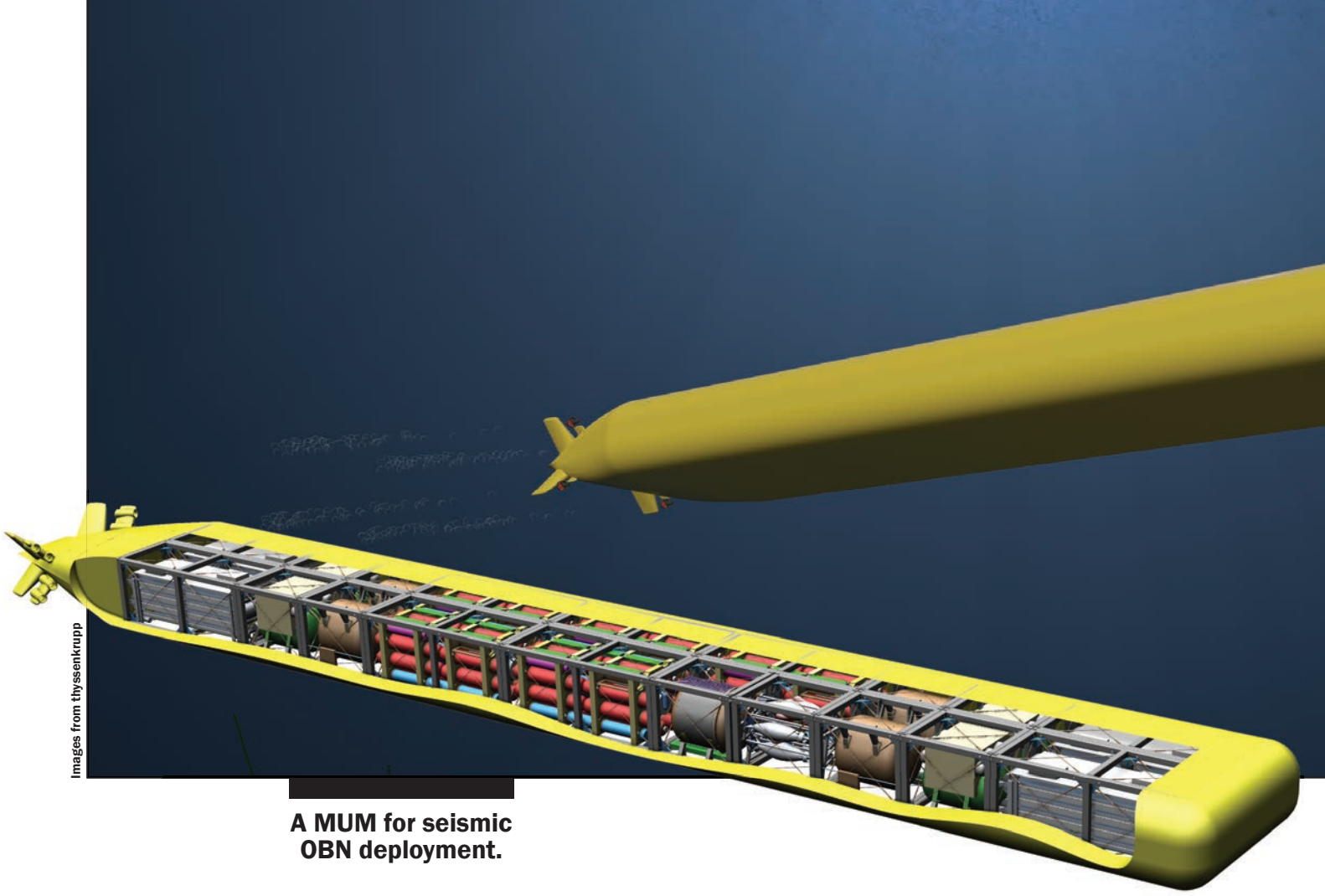
The system will support subsea survey in shallow waters as well as in deep and ultra-deep waters, operating a wide variety of payloads ranging from more conventional types such as side-scan sonar and multibeam echosounders to more advanced such as synthetic aperture sonar.

uSEA is looking for partners to complete the qualification programme, which is expected by the end of next year (2020). After that, the company is targeting operations in the sea and it's looking for pilot projects to perform in 2021.

An iDROP in the ocean

Another Norwegian technology firm, iDROP, is planning to disrupt the seabed seismic technology market with its autonomous Oceanid nodes. iDROP's system is based on individual cylindrical sensor nodes (named after Greek sea nymphs) that are dropfall deployed, using gravity and ballast shift for propulsion and position control, to land at specific pre-planned positions on the seabed where they land on aluminium legs which pop out before they land.

The idea is that they can be deployed in groups, falling to form grid patterns on the seabed for seismic surveys. Onboard batteries power the descent control (using just 5% of the battery doing so), data harvesting (for 180 days) and trigger a mechanism that releases the



Images from thyssenkrupp

A MUM for seismic OBN deployment.

30kg ballast – made of salt slurry – allowing the units to glide back to the surface, again, under control so they aim towards an expected target. A surface system with a floating conveyor belt type arrangement would then collect them.

"There's a variety of seismic acquisition technologies out there that are mainly towed," says Kyrre J Tjøm, iDrop's founder and CEO, who has previously worked at Schlumberger and consulted for Equinor and Seabed Geo Solutions. "There are also nodes that are placed on the seabed by an ROV. There are others where you dump them over the side with concrete ballast and some propelled alternatives. Our system will remove the necessity for large specialist vessels with heavy handling machinery and time consuming ROV operations."

Groups of Oceanids can be deployed fast and sensor point granularity (i.e. area coverage and therefore how much data be retrieved) can be increased, he says. This is thanks to 69 degrees to vertical autonomous lateral displacement capability, with each node "falling" to a pre-set position. "If you want to deploy a sensor in 1200m water depth, you can reach 2km away from the surface vessel and install a patch of sensors, rather than a line," he says.

Batches of nine nodes, each with an inductive modem, transponder and seismic sensor payload, could be deployed in 15 minutes, a 10-fold time saving compared with established methods, Tjøm says. A digital twin, based on extended modelling and testing, would be used to help identify any environment impact, eg. waves, current, depth, etc., and therefore enable control of the descent.

"We are looking at revolutionizing the way ocean bottom nodes are installed on the seafloor," says Tjøm. "The competitors do 40-170 a day per and need two ROVs, DP-controlled node handling systems, a large vessel and specialized crew. The deeper you go, ROVs are slower as they need more thrust to pull the umbilical. We would do just less than 1000 per day with a standard marine crew."

A lot of work has been put into the Oceanids project behind the scenes and it's only now that the technology is being promoted. In fact, the project started in 2010, with a prototype built in 2013/14. iDROP has also built a recovery system and performed an inshore test, for verifying the recovery system. A second pilot test, acquiring 3D seismic data, in deepwater, is planned for this year in the North Sea. Nine vehicles have been built and were due to go offshore for testing in the first half, with more planned to be built in the coming year.

MUM's the word

thyssenkrupp Marine Systems (MS), part of the German industrial conglomerate, is working on a different scale to both uSEA and uLARS. The firm is designing a very large (up to 50m-long) unmanned underwater vehicle (UUV), called a modifiable underwater mothership (MUM), based on a modular design, comprising basic and mission modules.

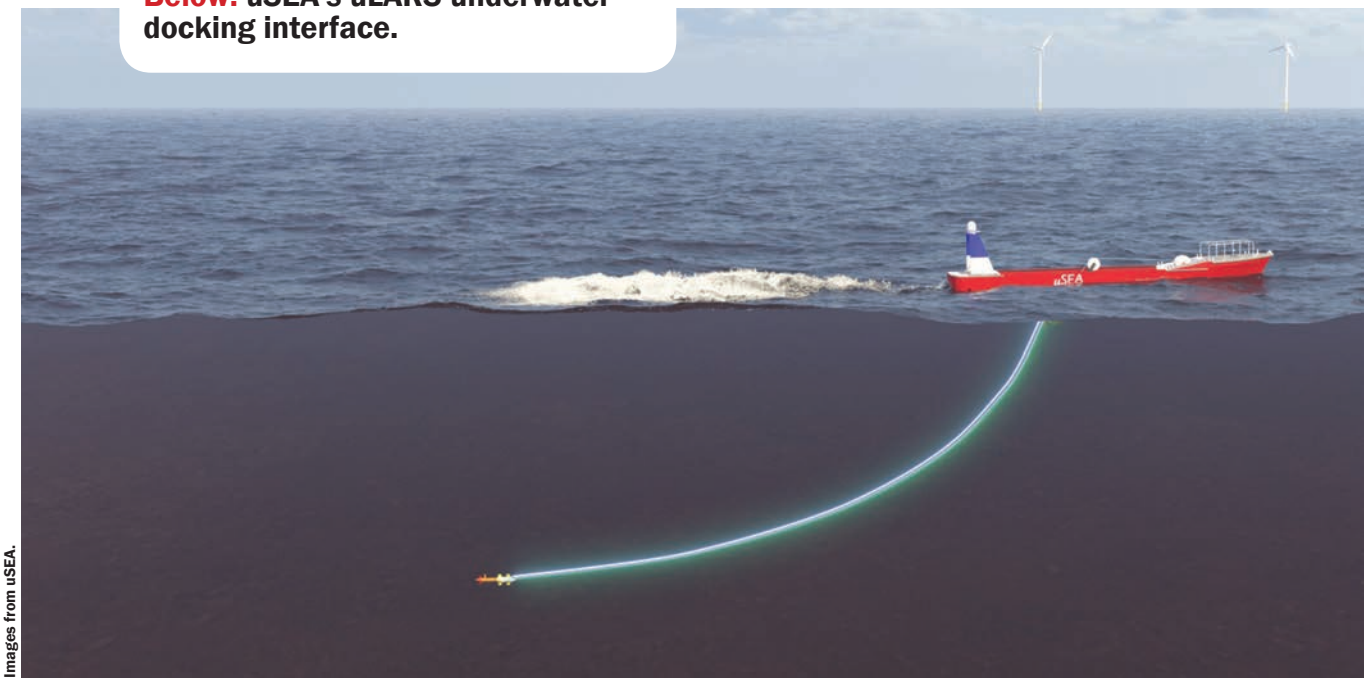
Table 1: Rough values for specific vehicle configurations

	MUM Configurations		
	SCM Exchange	**Seismic Node**	**Drilling Rig**
Approx. weight	230 t	330 t	150 t
Length	29 m	50 m	25 m
Width	7 m	7 m	2.5 m
Height	2,5 m	2,5 m	7 m
Power/Energy supply	Up to 160 kW (up to 6000 kWh net)	Up to 160 kW (up to 15000 kWh net)	Up to 160 kW (Up to 6000 kWh net)

thyssenkrupp's MUM concept.

The thinking behind it is that today's subsea underwater vehicle market is dominated by specialized products, with no one vehicle able to be used for multiple tasks. So, thyssenkrupp set about designing a modular system, says Willem Hendrik Wehner, who supervises the project at Thyssenkrupp MS.

Basic modules would be trim and diving systems, battery, propulsion and a hydrogen fuel cell. Then, mission focused modules could range from ocean bottom seismic node (OBN) deployment (>1000 OBNs) to core drilling systems, or from subsea control module change out to hosting remotely operated vehicles, which would use the large UUV as a mother ship. A MUM modular kit would consist of modules that have the size of standard 20 ft. or 10 ft. containers. They can be combined according to the mission specifications resulting in quite different vehicles, from 80 metric tons to above 300 metric



Above: uSEA's uLARS surface drone.
Below: uSEA's uLARS underwater docking interface.

Images from uSEA.

tons, or from 20m-long, 4m-wide and 3m-high to about 50m-long, 7m-wide and 3m-high, with power consumption dependent on the payload and propulsion speed.

"Other underwater vehicles do have modular approaches, but mainly in terms of an adaption of the payload section or extending the endurance by adding more energy capacity," says Wehner. "A good example is the SeaCat AUV of ATLAS, which can change its payload by swapping the head of the vehicle and can extend the range by adding more battery capacity."

Wehner says the MUM vehicle would be able to travel hundreds of miles, depending on the vehicle configuration, with its 80-160kW hydrogen fuel cell power, and down to thousands of meters water depth. "The underwater range is scalable and in the region of 100s of nautical miles; completely sufficient for the current use cases," he says. "Our gas storage system for the fuel cell is about three times superior to batteries with regard to energy per volume and even more regarding weight. However, if you want to cover more than a 1000 nautical miles, we would recommend a near-surface transit with a more conventional e.g. diesel-electric approach. The concept allows for this."

Hydrogen fuel cells are a proven air-independent technology for thyssenkrupp submarines; the company has profound experience with hydrogen fuel cells in the German HDW Class 212A submarine as well as other submarines. Batteries might be necessary for peak loads of some payloads, but most of the current MUM vehicle designs only have a small sized backup/emergency battery, says thyssenkrupp. A module for surface or near surface transit is being designed at the moment, as the fuel cell system has its strengths for enduring underwater tasks.

For long range communication, on long missions, thyssenkrupp MS is looking to use self-propelled modems, or autonomous communication nodes, with bi-directional data transmission capability, to create long-range acoustic communications through a chain of these nodes, as well as local navigation or 3D positioning via USBL modems. These are being developed under a subproject called NaviMUM by EvoLogics and would be deployed from a revolver magazine on the MUM.

EvoLogics calls the concept a self-organizing mobile underwater network, with the nodes forming relay stations as well as providing positioning. They would autonomously fan out in a mission area, analyze the communication environment, then hold the position and interconnect to form a flexible underwater network. Some would have a GNSS receiver, to get periodic real position fixes, says Wehner.

"Very large vehicles like the MUM in particular need strong sensors and algorithms for autonomous obstacle avoidance and track re-planning," says thyssenkrupp. "Self-adjusting control algorithms that reflect the large variety of possible vehicle configurations will support the vehicle's concept. The project develops a mobile communication and navigation system with self-propelled LBL/USBL modems that can establish a network and dock at the MUM vehicle for transit and charging."

thyssenkrupp MS is building a small-scale version of the MUM, at 5m-long, which will be ready for testing this summer (2019). Many of the concepts, in particular the autonomy software and the mobile communications, will be tested on this system. The core technologies like the new hydrogen fuel cell as well as a new pressure hull design will also be tested, in real size, this year.

A real-scale MUM vehicle is due to be built at tested from 2020, with testing and trials up to 2023-24. The development is being supported by an advisory panel from the oil and gas industry including operator Equinor, seismic company PGS and subsea contractor Boskalis.

The company also has Atlas Elektronik, the Technical University of Berlin and the University of Rostock working on the project, on the control system and system simulation respectively.

A New USV for C

A new unmanned surface vehicle (USV) designed for the Chinese market offers an open and low-cost platform to measure water current and direction. Nortek China has integrated Doppler instrumentation on the vehicle to help better meet user requirements for ocean surveying.

The new USV has an IPC (Industrial Personal Computer) as the main operation platform and uses Remote Desktop, a remote control technique, to communicate with all the instruments installed. This means that the vehicle offers an open and low-cost platform for customers who need to carry out several different tasks at the same time. For example, users can perform hydrology and water quality measurement while simultaneously obtaining water samples. Furthermore, the USV can carry other appropriate instruments, for example for geomorphology.

The basic exterior dimensions of the vehicle are about 200

All photos courtesy Nortek

Ocean Surveying

x 70 x 40 cm. The USV has two propellers that can produce 80 pounds of thrust force. For navigation control, it can be remotely controlled manually, or be programmed to sail automatically by itself. The design of the vehicle can be adjusted according to different requirements from end users.

"The demand for USVs is growing in China now, and China is a great market in itself. With Nortek having launched the Signature VM system here already, we should grasp this opportunity to open the vessel-mounted current measurement market in China," said Leon Zhang, General Manager of Nortek China.

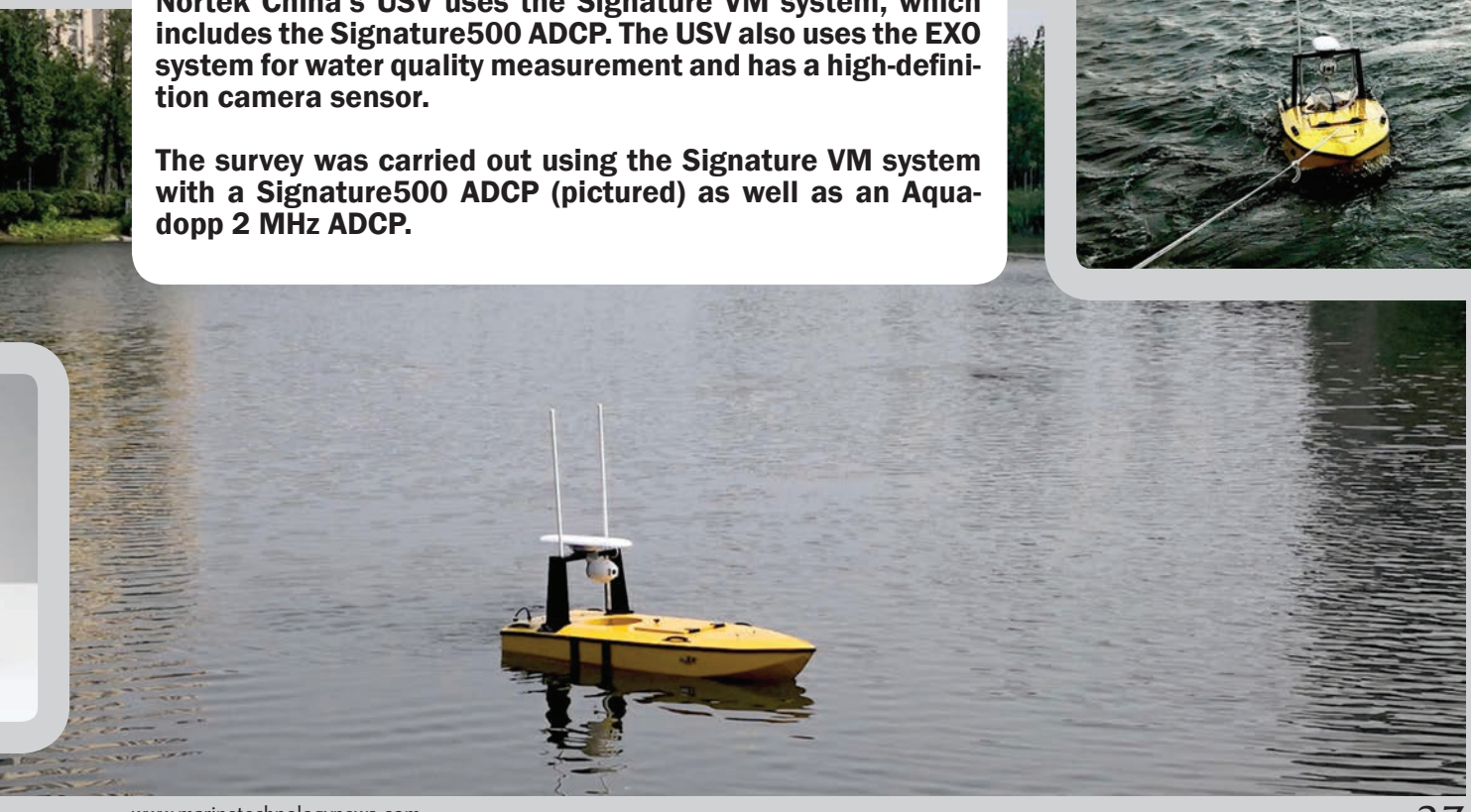
"This USV platform was built to help users to handle multiple tasks, and to be able to do this at a low cost. Looking ahead to the future, we will develop an automatic and 'intelligent', or sophisticated, system to improve the performance of the USV," said Jack Hu, Technical Manager at Nortek China.

Clockwise, starting left: Nortek China USV used by China University of Geosciences for measuring the current profile and the vehicle's velocity during drifting. The image shows a deployment in the South China Sea near the city of Zhuhai.

Testing the USV's systems in a bay near Qingdao, China. The test includes boat stability (by hauling/dragging the vehicle) and communication quality.

Nortek China's USV uses the Signature VM system, which includes the Signature500 ADCP. The USV also uses the EXO system for water quality measurement and has a high-definition camera sensor.

The survey was carried out using the Signature VM system with a Signature500 ADCP (pictured) as well as an Aquadopp 2 MHz ADCP.



Deploying the Kraken Katfish

Photo: Leeway Marine

The game has changed

Offshore Survey Vessels are Ready for Faster Sensors

By Jamie Sangster, CEO, LeeWay Marine

In 2009 I wrote a thesis on the use of unmanned systems for defense applications. At that time, the three buzz words of "dull, dirty and dangerous" dominated the narrative about what they are used for. Those words made perfect sense in the context of military applications where value is quantified in the effectiveness with which the mission is executed: you locate an explosive mine over the course of several hours searching without risk to humans and with less margin for human error. Fast forward 10 years, now in the role as CEO of LeeWay Marine, I am again evaluating robots, but from the perspective of finding a commercial solution that offers a competitive edge.

LeeWay owns and operates survey vessels from the Center for Ocean Ventures and Entrepreneurship (COVE) in Dartmouth, Nova Scotia, Canada. COVE is one of several ocean technology hubs in Atlantic Canada (Canada's four easternmost provinces including Newfoundland and Labrador, Nova Scotia, Prince Edward Island and New Brunswick) and, therefore, we are immersed in a community which is hell-bent on developing the latest and greatest (sometimes not) ocean technology. We see it, mobilize it, launch and recover it (if all goes to plan) and evaluate its effectiveness for commercial use. AUVs, towed robotics, synthetic aperture sonars, multi beams, acoustic sources, acoustic arrays, mine hunters, submarine hunters, oil hunters, fish trackers, ROVs, drop cameras, UxVs; the list is endless, and we love every second of it.

In light of that, I can postulate over this robotics conundrum with a reasonably experienced and increasingly discerning eye. I know with certainty how important unmanned systems will be in the geosurvey ecosystem of the future, I also know that the end clients (oil and gas producers, offshore wind farm owners, IT companies, national hydrographic agencies, etc.) are increasingly confident in the data harvested by these machines. I watched real-time as Kraken Robotics' KATFISH (towed synthetic aperture sonar, SBP, MBES) was hovering 10m above the ocean floor, being towed at 8 knots and capturing high resolution imagery of a never-before-discovered wreck in the North Atlantic. I watched the faces of experienced hydrographers who couldn't believe the level of automation associated with post-processing and the speed with which the product could be delivered to the client. So, given the operational efficiencies robotics can inherently deliver, one would expect them to be the panacea to satiate any offshore infrastructure developer's hunger to find efficiencies in survey operations. Yet, as we monitor the offshore survey market, one need only check AIS Marine Tracker in various prolific survey regions to see… same ol', same ol' large floating hotel/survey vessels shepherding around a precious sonar head about the size of a dinner plate. To be clear, that's exactly what we at Leeway still do!

Barriers to innovation

Why is it, with such great survey robotics on the market, do we find ourselves "in irons"? Having debated this issue at length with many broad-minded industry experts, one of the classic lines is that ship owners/survey companies have too much capital tied up in vessels and other survey assets. This introduces significant reluctance to move aggressively towards robotics. While there may be some truth to that, I would argue, based on my observations, that large multi-national survey companies are in fact the early adopters of this technology, influencing and enabling their use in a broader market. From my observations, squeezing the remaining value from existing ships is not why ocean robotics are making a slow entry to the

Photo: Leeway Marine

LeeWay Odyssey transits to Bedford, Nova Scotia to test the Kraken Katfish.

survey market.

The actual problem, based on the analysis we've done, is that robotics alone will not yet force a paradigm shift because they don't significantly improve the overall value proposition to force (or even allow) large survey vessels to be tied up. Particularly the vessels with geotechnical capability, something robots have yet to influence. From our perspective, most UxVs on the market, with the exception of XOcean's XO-450 and Kraken's Katfish, have been developed to target competitive, tactical capability enhancements rather than a solution to a strategic commercial problem. Vessel operators and survey companies generally still require medium/large ships to launch, manage and recover UxVs and host the contingent of surveyors and marine crew. Increasingly, data post-processing also happens aboard the vessel during the data acquisition phase so a product can quickly be delivered to the client and the project can be monetized. If nothing else, the ship is just a hotel which may or may not use robotics. If robots are present, value on that operation is likely based on effectiveness or safety rather than efficiency.

For example, carrying a 3000m depth AUV on the back of our 140 ft. survey vessel is certainly possible (lets carry four). We have a fantastic launch and recovery stinger to do that. The reality is, recovering costs associated with buying or leasing the AUV more than triples the project cost compared to the old fashioned (and reliable!) hull or pole-mounted MBES. We'd never win the bid, plain and simple, if we are trying for any actual ROI, with an AUV. In the alternative, let's try a few USVs; they're a bit less onerous in terms of costs and risk management. Strap a LARS on the port and starboard decks, launch a few USVs and increase your efficiency by doing 3 transects at once. Add two techs and two USV operators to the existing brigade of 12 surveyors, two marine mammal observers and two archeological observers and you find yourself in an 800-ton survey ship simply to accommodate all the brains and eye balls. It turns into a dog's breakfast and it's not worth the trouble.

Alternatively, lets eliminate the ship completely and take a 5m USV at 4 knots, launch it from the government wharf in Sambro, Nova Scotia, send it a few nautical miles into the North Atlantic, and watch the "Sister Islands" have their way with it. It doesn't matter how many naval architects analyzed the hull form; there is no 5m anything that can take the "Sisters", period. If it is so lucky, such a capable vessel will operate with impunity for 10-15 days collecting terra bytes of great data. That concept is quite sound in my opinion and offers a very decent ConOps. It isn't without flaw or risk in the context of geosurveys as the rich data is locked aboard and "hopefully" the data is good. There are some additional operating concepts that could be applied here including smaller, fast support vessels and unlimited broadband VSAT solutions which may make it work well.

Who owns new value creation?

In our view, there are several interesting permutations and combinations of UxVs coupled with vessels that can be applied to create a decent solution set; but, no matter how you slice it, it becomes a race to a converging minimum viable solution. From what we see, the shift to robotic dominance is simply

LeeWay Striker heading to refit in December 2018.

Photo: Leeway Marine

trading value from the owners of one capital asset to another. From a large, expensive and relatively non-complex asset to one or several, highly complex robotic assets. Medium term operational efficiencies will certainly be found in the various ship/robot permutations and relationships, but that will only result in margin for the asset owners as robotics owners use comparative ship costs as a baseline for their pricing strategy. Vis a vis, a robot can save 20% compared to a vessel day rate. Why wouldn't they do that; they'd be leaving value on the table by doing otherwise. So, developers will pay about the same as they do now for the processed data. Moreover, when I look at this problem from the perspective of the developers; it's no surprise that large ships still dominate. Why take the risk of something new if it basically costs the same? There's already enough risk in these projects, why take more? The value prop isn't yet there for mid and offshore surveys.

If we're serious about increasing productivity, there must be a fundamental shift in the overall methodology - one that considers the full spectrum of technical advantages associated with vessel designs, sensor technology, autonomous platforms, power density and machine learning. I'm positive AI and blockchain methodologies fit in there somewhere. When we tackle this problem at LeeWay, we start with three fundamental realities:

1. Collecting geophysical data requires a physical object (ship, satellite, AUV, UxV, buoy, etc) to be present at the point of acquisition; therefore, the volume of data collected is primarily a function of distance travelled.

2. Commercial value is always measured as a function of time (revenue per period). Processing the data quickly matters to the whole value chain.

3. Efficiencies in acquisition methods, sensors and processing will ultimately begin to converge towards a monolithic solution with consistent operating margin. Similar to the passenger aircraft industry where operating efficiencies have become so finely tuned and industry wide, only marketing and sales matter, generally speaking.

Speed is what matters

Since value is measured over time, the volume of commodity (in this case data) per unit time is the fundamental influencer on total potential value. All things being equal, increasing the volume of "post processed" ones and zeros per unit time is the only way you can possibly have a growing revenue curve per asset. Therefore, value is directly related to speed of data collection/processing and only speed.

Speed on the ocean is not new. LeeWay recently commissioned North America's fastest offshore data acquisition vessel which has a max speed of 55 knots. Install 5400hp in a 100,000 lb. boat and voila! However, regardless of the installed power and stability offshore, as soon as the sensors are turned on, we cut the throttles to 6-8 knots because that's the sensor's maximum performance speed as designed. To be clear, the game changer is not about the vessel at all, it is about the speed at which the sensors can effectively operate. If you're reading this and, in a position to influence the direction of your product development and research, think speed. When I say speed, I mean 20-30 knots and higher. I know the physics is hard, I've been cautioned several times. Nonsense. It hasn't been developed because there hasn't been a need. If you want to change the survey industry, build an MBES or SAS that can operate at 25 knots. Let everyone else spend their time polishing the

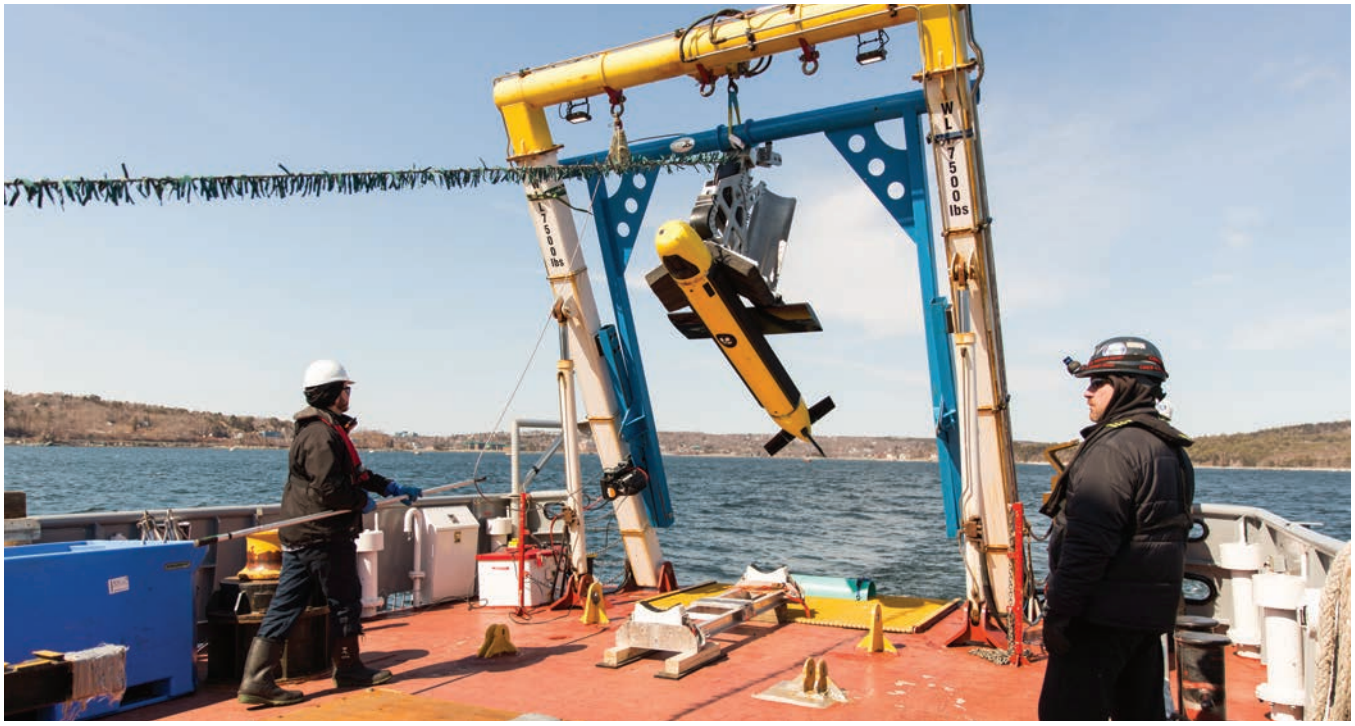


Photo: Leeway Marine

apple with ultra-efficient eco USVs and AUVs, meanwhile, your 25 knot MBES will completely upset the apple cart.

The three speed fundamentals:

- Speed is the most influential variable that will impact the volume of monetizable product over a specified period.
- Speed reduces time and time drives all operating costs on the ocean.
- Speed brings the offshore closer to home, offers surgical operations and significantly reduces weather risk.

Once speed is well established, then the suite of operational efficiencies such as autonomy, power density, platform stability, data transfer rates, etc. will actually matter in a scalable way. It is conceivable that the final solution could be approached from two opposing directions. The first could see a solution derived from existing UxVs, scaling to larger, faster platforms. The second would see high-speed, medium-to-large vessels being designed with autonomous technology as a fundamental operating system. In my mind, the ultimate solution is quite evident and based on the physics of the ocean. Added mass of water requires vehicle mass in order to counteract momentum; hence, I side with the concept of starting with substance and building from there.

From our perspective, all efforts to improve efficiency on the ocean are important. Eliminating people at sea, using smaller, more efficient platforms with longer endurance, better coverage rates and higher resolution are all marginal value propositions that matter. None of those elements stand to unlock value like introducing sensor speed.

NORBIT DCT

Hydrographic Survey Made Easy

By Pawel Pocwiardowski, Product Director, Sonar Systems, NORBIT Subsea

With the increasing number of maritime operations worldwide, more and more hydrographic surveys are required to be conducted. This exerts a demand for hydrography providers with survey capabilities ranging from single-beam to multibeam echosounders, sub-bottom profilers, lidar, and magnetometers. The developed markets with a long history of bathymetry and hydrography surveys are well prepared to serve the increased demand with professional hydrographers, equipment and software support. However, in emerging markets and developing countries, the professional hydrography market requires a different approach as the backlog of professional hydrographic surveyors is not established yet. The current commercially available tools require ex-tensive training and understanding of the survey setup and for many smaller companies that presents a barrier which is very challenging if not impossible to cross. To address these emerging markets and the need for simple tools to perform basic bathymetry surveys NORBIT has developed the DCT – Data Collection Tool.

Contemporary hydrography needs

Nowadays hydrographic surveys become more and more commoditized due to the standardization of requirements and deliverables. The increased demand in various bathymetry mapping projects propels the development of standard tools and further facilitates the adaptation of the high-resolution mapping technologies across the industries. That ranges from safety of navigation projects, through dredging and various construction and environmental projects like habitat mapping and bottom classification. It crosses commercial markets as well as government and public agencies. These developments extend widely throughout the world from oceans and lakes to rivers, in-land reservoirs, port, channels and man-made basins. With the technology being easier and cheaper to use, the number of applications and use cases has increased dramatically in recent years. Especially an urgent need for integrated simple-to-use mapping and imaging hydrography technology has emerged in the transitional market of users of single-beam (or sidescan) to multibeam technology. That is driven by multibeam wide-coverage, high accuracy, high resolution and efficiency of survey.

For the past years, NORBIT has been leading the manufacturing of ultra-high resolution curved-array bathymetric mapping solution and its technology has been widely accepted by the maritime markets across the world. The integrated hardware offerings have set the grand entry path for the users of these systems, due to simple mobilization and operation of hardware. Survey organizations (commercial and government such as navy), have started to utilize small survey boats with a single person running the operations or utilizing unmanned surface vessels (USV). The cost related to running these survey operations can then be limited and more companies can perform bathymetry missions which in the past would not be in their reach.

However, the survey tools, available commercially, still prove to limit the full potential of the new emerging markets due to its complexity on both, setup, installation and operation as well as data post-processing and final product deliverables.

To address these emerging market needs, NORBIT has recently developed a survey utility called Data Collection Tool (DCT) to facilitate a simpler survey operation and provide a means to collect quality bathymetric data, ready to be post-processed and delivered to the end client.

What is DCT?

The Data Collection Tool (DCT) is a survey data acquisition utility, part of NORBIT's offerings aimed to simplify the standard bathymetry survey operations. The general bathymetry grid is displayed in a web browser allowing quick estimation of the coverage and data quality in real-time while running the survey.

DCT can be operated with a simple touch screen of the navigation plotter, tablet, smartphone or PC by a single person. By reducing the amount of configuration required by the user the real-estate on the screen is maximized allowing for a clear, precise and easy way to understand the interface. With a simple Start/Stop button the user can acquire the needed data which are then recorded on the survey PC. The skipper or boat driver can run the survey without constantly recon-figuring the system, allowing him to concentrate the efforts on safety aspects and any other tasks while running the survey opera-

Fig. 1: DCT operated via web browser on a rugged tablet.

Image: Norbit

tion. In cases where help from a more experienced surveyor is needed, the displays can be accessed from anywhere in the world (e.g. via VPN over 4G access) and from any terminal equipped with a web browser.

With a tap of a finger or by a mouse click users can draw lines, generate a number of wing lines with given spacing in just seconds. Each line can be adjusted, moved, rotated, re-sized or deleted as needed. The mission planning can be per-formed in the office or on the boat. Then the survey scheme can be saved as a disk file and emailed or shared with another PC to be loaded on the sur-vey setup. That allows for mission planning in advance and sharing of the survey plans with other team members. The mission planning can be supervised from the office as long as there is network access (e.g. via VPN over 4G) to the boat and simply navigating with the web browser to the survey PC. Then the mission planning can be shared and modified as needed.

A similar feature is available for maps. The Google Maps or Open Street Maps can be cached locally and made available on the survey PC to run the background maps even without the internet access.

Quality-driven mission execution

DCT offers four types of real-time display accessible via simple tap or mouse click under the layer menu button. These are depth, standard deviation, sounding density and backscat-ter. The depth by default is simply the depth from the sonar to the bottom and can be displayed in a projected reduced chart datum as well. The standard deviation and sounding density are produced per given grid size. By default, 0.5m grid size is selected but can be changed by the user. The backscatter is given as average intensity from each grid cell.

All four displays can run concurrently (see Fig. 4) on one or several clients, e.g. skipper can view depth display and surveyor or QA remote assistant can view standard deviation and sounding density display. The background maps (Google maps or Open Street maps) can be selected according to user preferences differently on different clients. Zooming, panning

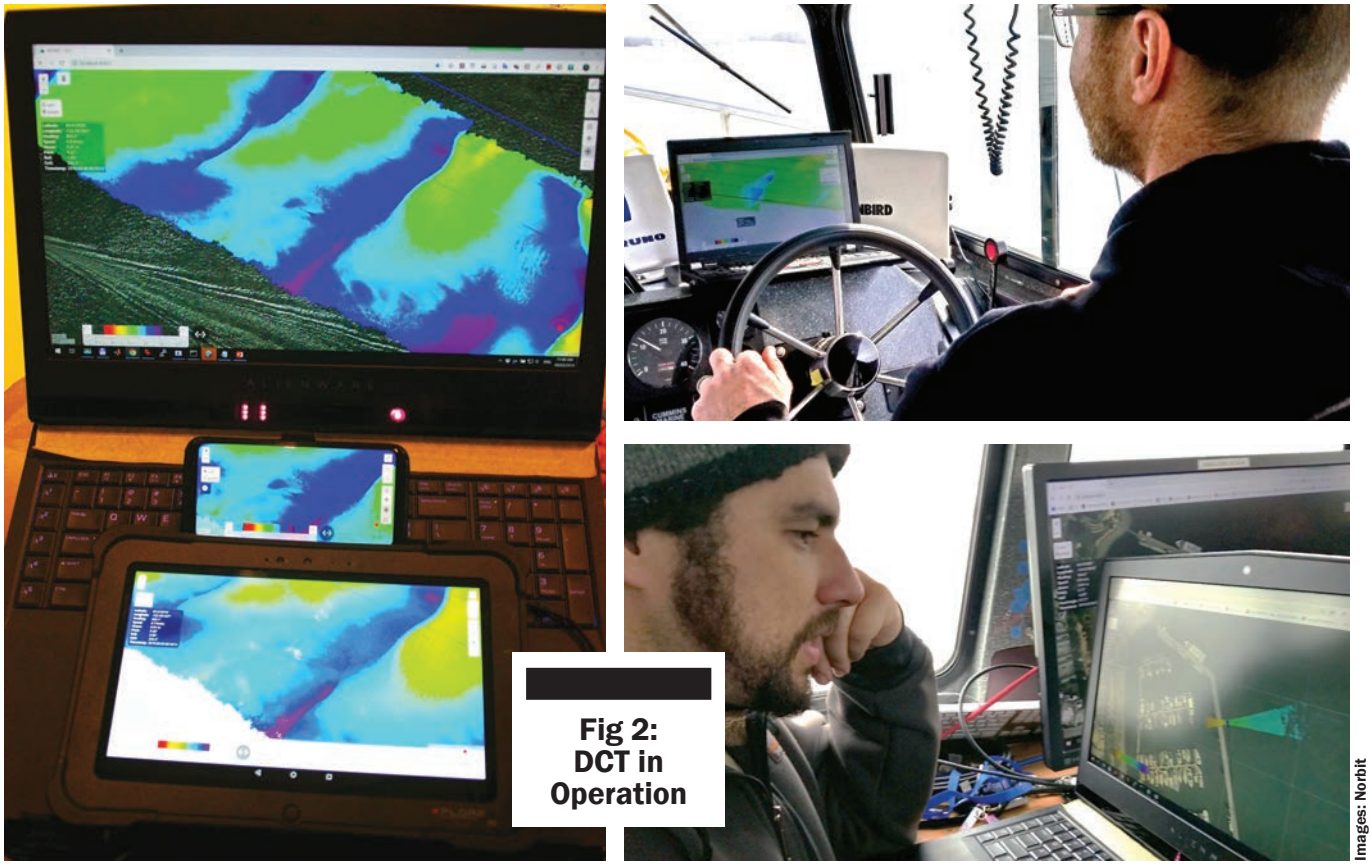


Fig 2: DCT in Operation

Images: Norbit

and boat location/tracking options are available also on all displays.

The entire data collection process is driven by Max Quality Rule, which is a unique offering from NORBIT. Each time the record button is pressed all raw sensor data (bathymetry, navigation, etc.) are being collected into the NORBIT local data repository (as a data file) and a new grid line is generated (as an entry in the database). The overlapping grid lines compete for quality, and the grid bins with lower standard deviation replace the data with high noise (high standard deviation usually meaning worse quality data).

The Max Quality rule is outlined in Fig. 5 where two lines are overlapping. The multibeam detections of outer beams, usually have a higher standard deviation (higher spread) than in the nadir region. The nadir region data will thus prevail and replace the gridded data of lower quality with higher quality data. This functionality makes it easier for the operator to collect the data with highest accuracy as DCT will always display high accuracy data over low accuracy data and will show the standard deviation on the color display allowing the operator to take corrective actions if needed.

The depth display will also be driven by the Max Quality Rule and adequately follow the standard deviation display and show high-quality data over low-quality data. In that way, the operator can take quick corrective actions and re-run the areas with low accuracy to ensure full coverage with properly collected data. It eases the tasks related to removing the bad data and simply running over the noisy data will replace them on the display (all original data is still recorded safely and preserved).

As a part of mission execution tools, users can, if needed, delete a portion of the grid or entire selected lines. This functionality allows for elimination of the erroneous overlapping grid lines from the display without the need to reacquire all underlying data. The data is only removed from the displayed grid to help operators better assess the quality of the collected survey data. That saves time and greatly improves the efficiency of the survey.

Where DCT can be used

The primary use for DCT is a simple standard survey where the multibeam integrated GNSS/INS system constitutes a complete solution. NORBIT iLiDAR laser sensor support will be added in future versions. The ease of use, however, qualifies the DCT to be used on various platforms starting from one-man operated surface vessels to recently blooming market of USVs.

Especially for USVs the DCT offers a great advantage as the entire data collection can be done on the local drive onboard the USV and only the HTTP-based map with coverage and quality indicators are transmitted over to the operator using any web browser device. Several USVs can be monitored using the same terminal or PC as long as they have a radio connection. Even if the radio link to the monitoring terminal

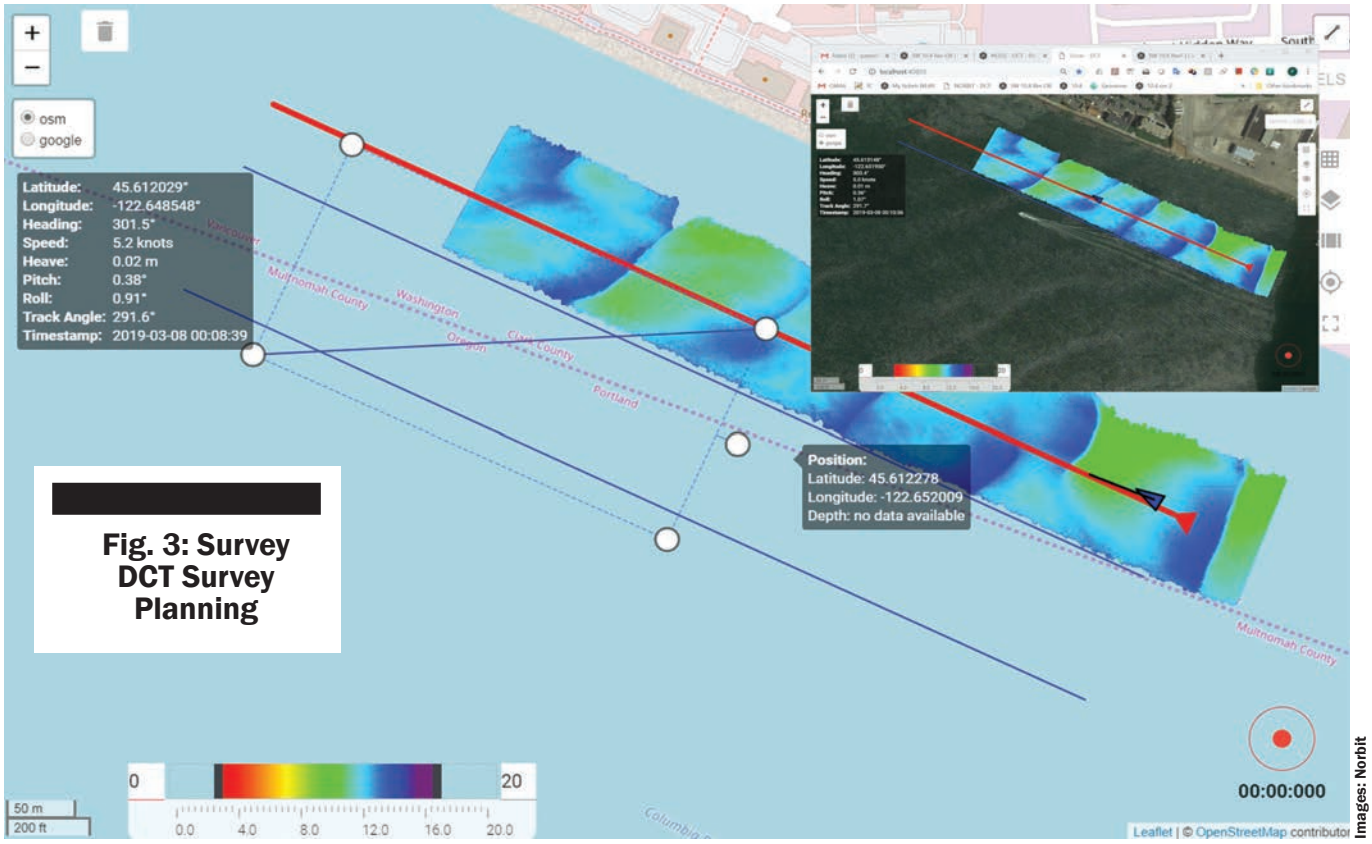
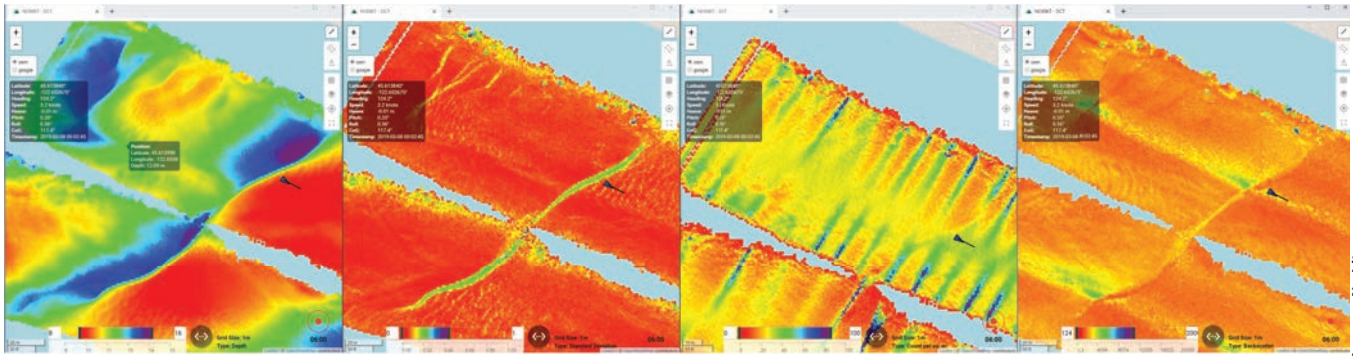


Fig. 3: Survey DCT Survey Planning

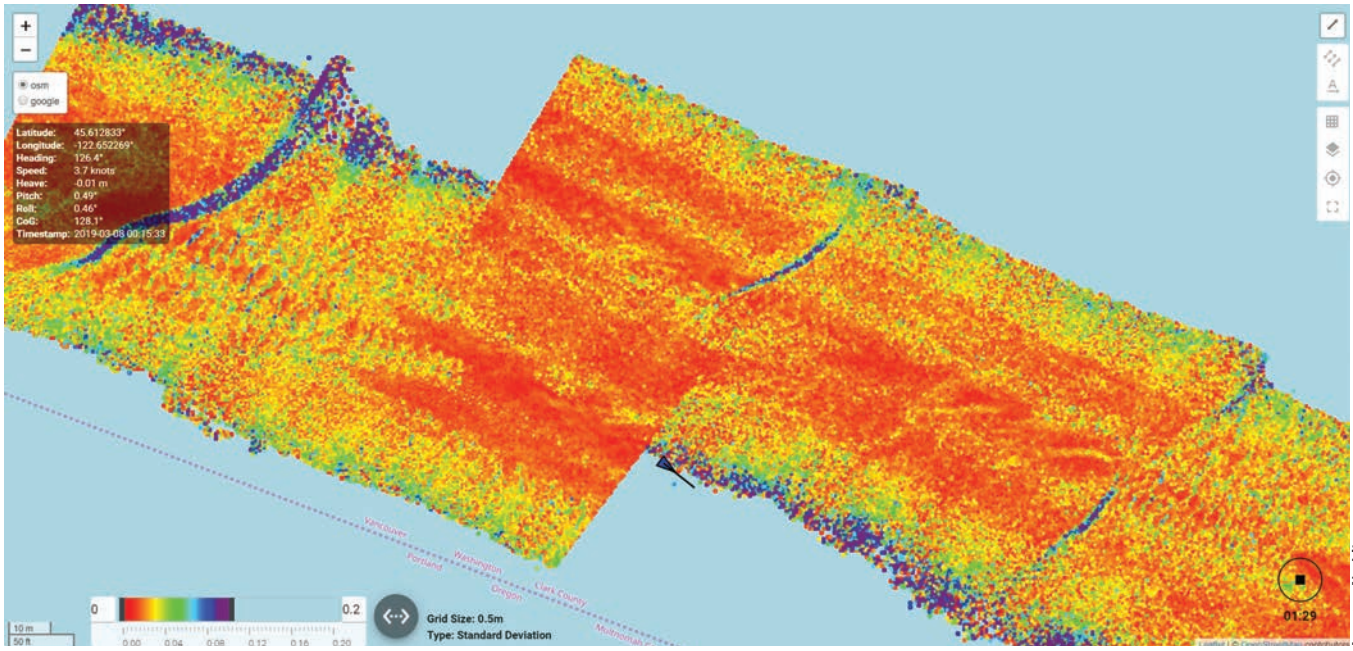
Images: Norbit

Fig. 4: DCT's four available displays



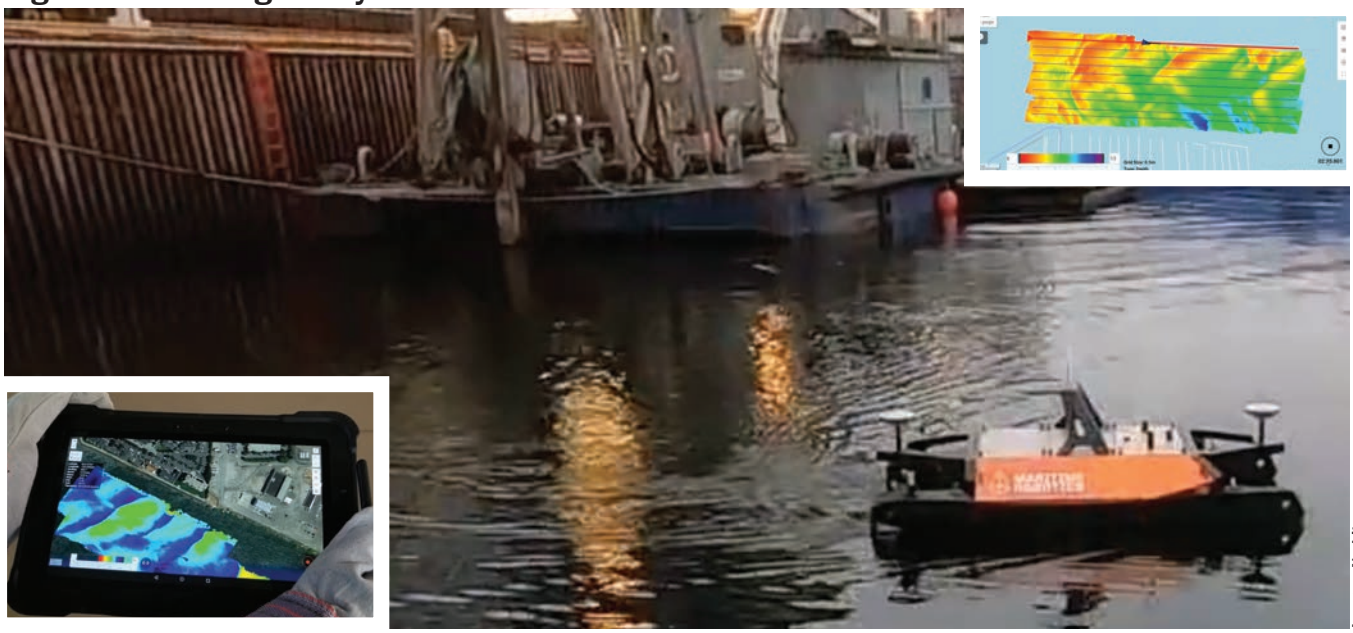
Images: Norbit

Fig. 5: DCT standard deviation display. Max Quality Rule operating on two overlapping lines and keeping better quality data for displaying.



Images: Norbit

Fig. 6: USV running survey with DCT.



Images: Norbit

breaks down, the data is securely stored on the local drive and once the connection is re-established the image re-appears on the monitoring terminal.

The USV manufacturers can use the web browser directly or easily integrate the HTTP based DCT's protocol via NORBIT's Open Source Hydrography platform, which is a DCT backbone and comprises of tools and utilities allowing for data access and manipulation similar to the web browser operations. The access is facilitated by open source frameworks which are supported by the GIS community all around the World. The DCT supports both Windows and Linux operating systems that allows for integration to multiple platforms and multiple manufacturers.

Post-processing and product delivery

It is important to note that DCT is not a bathymetry processing software. It is a utility to securely and efficiently run hydrographic surveys, collect high-quality survey data and make them available for the processing software. The DCT records the data in NORBIT.wbm file as well as in popular *.s7k file. The s7k file contains all raw bathy points and navigation datagrams which makes it very easy to drag and drop to processing software such as CARIS HIPS&SIPS or Qimera and start the data processing right away. It is also possible to use automated tools such as CARIS on-board or Qimera Live for immediate processing results. The data is always collected in WGS84 coordinates, and all data is time stamped in the NORBIT hardware. The speed of sound profile is also saved in the same file (or can be added to the processing software if needed). At the same time the raw GNSS/INS observables are recorded and allow for navigation postprocessing of a complete navigation solution even if the RTK dropout happen during the survey or no RTK was available at a survey time.

Conclusions

NORBIT's latest Data Collection Tool (DCT) is a simple and useful tool for new markets to emerge onto the hydrography survey world. The web browser interface allows conduction of the survey in an efficient way. It is suitable for small boats and single person operations as well as unmanned vehicles with low-bandwidth radio connectivity to the operator. DCT concentrates on data quality and helps the operator gather high-quality data with Max Quality Rule operating in real time. Through web-based displays, DCT allows access to the survey results and monitoring of the progress from any terminal in the network either local or remote.

Offshore Wind

One-stop power conversion

With the United States and China about to start their respective offshore wind build-ups, *grid operators wondering about the efficiency of their turbines or the emissions-areas compliance of their wind-service vessels will be warmed to know there's someone they can talk to. Yaskawa's The Switch — a Japanese industrial giant's European environmental tech business — is offering one-stop wind-energy shopping. As with shipping, you can order permanent magnet generators, drives and converters for your wind turbines. Take heart. The lingo is the same.*

By William Stoichevski

Yaskawa's The Switch is well-placed to hybridize vessels or help convert power from wind turbines. In the U.S., they've quietly built up a $500 million business in low-voltage and medium-voltage drives, with some sales of solar inverters on the side.

Known in the North Sea for permanent magnet generators and frequency converters for wind turbines and marine power and propulsion, The Switch's specialty is where the generator shaft meets the propeller shaft, with efficient drives for power outputs of from 0.5 kW to 11 MW.

Their marine permanent magnet machines can be used as gen sets or motors, and new drives come with configurations that download to a mobile phone and are a shipowner's path to battery-powered hybridization. When Yaskawa bought the company in 2018, that was part of the allure of Wartsila's power drives division, now called The Switch: the bought business offered scale, high-voltage drives, marine-market savvy and "green tech". When acquired, The Switch had been focused on providing wind-turbine drives and marine shaft generators when Wartsila sold it to Yaskawa, which had smaller-capacity generators and a large range of industrial offerings, including its own drives.

Incredibly, permanent magnet generators and frequency converters for wind turbines and ships can be talked about together, if you like one-stop shopping: "In general, the technology is quite similar. But we customize the technology for the specific end application," said The Switch's director of product marketing for marine solutions, Ville Parpala, who didn't mind indulging us.

"Some requirements are different for marine. For example, there are differences for the cooling system. Marine applications can use fresh water, for example, but wind needs closed-loop solutions. The generator speed is also different, and more redundancy is required in marine applications," he says, not minding that we're comparing towering wind turbines to wind-service shipping.

A similar discussion

"There are also different regulations, such as the strict classifications for marine. But in the end, marine and wind are very much alike. In wind, the goal is to put as much quality electricity into the grid (as possible). In marine, the goal is to

Image: Fred Olsen/Handout

Optimized drive:
Fred Olsen Ocean's Brave Tern.

slash operating costs and fuel consumption."

Similarities aside, the timing of the company extending its global reach is perfect at this the dawn of U.S. — and, it seems, Chinese — offshore wind expansion. By some estimates, the U.S. offshore wind industry alone, still in the planning and acquisition stage, is a $70 billion market in-waiting. According to World Watch Institute, China is hoping to be 40 percent wind powered by 2050.

Yaskawa Environmental Energy, of which The Switch is a part, is the combination of a robotics savvy, mainly low-voltage industrial giant with a high-voltage marine power company which has delivered converters to over 6,000 wind turbines in China alone. The new Yaskawa company has also begun re-equipping part of the Norwegian offshore fleet with multiple-megawatt electrical drives while also kitting out the first, heavy-duty offshore-service vessels.

With the worldwide shift toward installing larger wind-turbines, a major wind-park and wind-carrier consideration in the US and China. The Switch — with its PM machines and converters ranging for applications from 500 kW to 8.0 MW — and the Yaskawa line of medium-voltage converters meet that coming challenge of scale.

Marine scale

In the first encounter with large offshore turbines off the U.S. Eastern Seaboard, the site of Fred Olsen Wind Carrier's 15,000 GT Brave Tern jack-up wind installation vessels wind installation vessel easily handling and installing turbines was a sobering sight for those who had seen the very first turbine assemblies with smaller vessels. Those first installs were

Optimized drive: Fred Olsen Ocean's Brave Tern.

Image: Fred Olsen/Handout

bold, given the size of the vessels used.

"In marine, people's lives depend on what you do," said Parpala. "In wind, people rely on the quality of what you deliver. In a highly electrical world, it's important to have high reliability at all times."

As it happens, that pioneering Fred Olsen vessel — now at work in the U.K — was kitted out by The Switch. Apart from its ample specs and cranes, the Brave Tern employs dynamic positioning that allows the vessels to work around the wind turbines while not anchored.

In 2012 and 2013, The Switch delivered the drives for the propulsion machines of both Brave Tern and the Bold Tern. During the build by Lamprell shipyard in Dubai, the three motors that came from another supplier were augmented with The Switch's delivery of three 3,800 kW propulsor drives; three 2,700 kW tunnel thrusters and, in is understood, a DC Hub for each vessel.

Future wind-service vessels look set to face an increasing amount of environmental scrutiny and can expect to one day have to operate as hybrids. New wind players are often national grid managers involved in wind precisely for the green footprint. Even established players with roots in oil, like Equinor, have been known to insist on greener power from their marine suppliers.

"Our drives match turbine installation vessels very well," Parpala said, explaining that specialized crew carrying vessels are generally too small for the company's multi-megawatt equipment class.

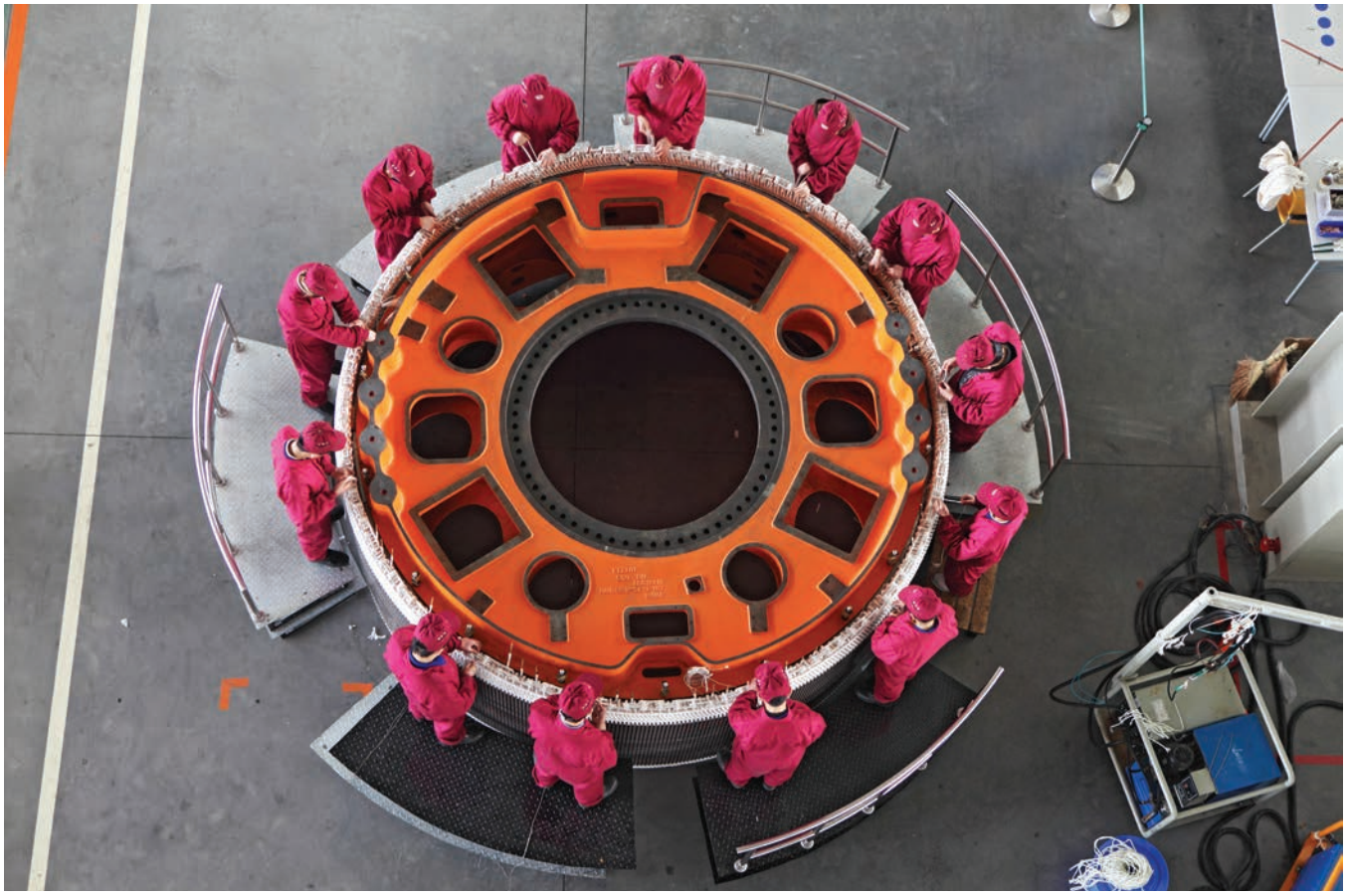
"Generally, we have a good match whenever dynamic positioning is required. Our electrical drives and converters are ideal for any hybrid vessel, especially when they have DP2 or DP3, which is important for wind-supply vessels. Our drive products are already designed and delivered for this.

"The benefits of using our DC-Hub and (Electronic Bus Link, or EBLs) as well as our power drives is that you can use batteries for higher lifting capacity," he says, suggesting again that future heavier turbine lifts might need that flexibility.

North Sea Giant

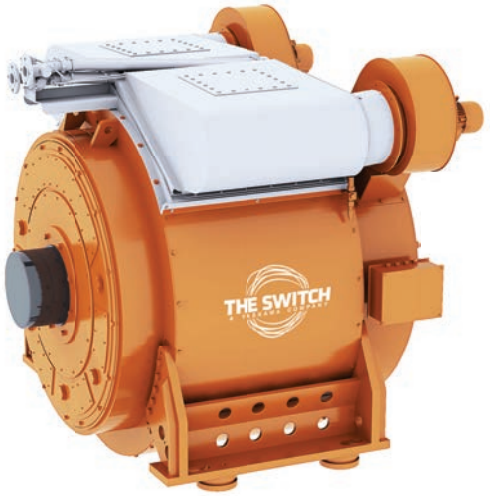
North Sea Shipping Company's subsea construction vessel, North Sea Giant (built 2011), is a Yaskawa retrofit reference that recently made headlines for undergoing a conversion that would give it the kind of performance reliability and power efficiency future wind-service vessels will need.

When we visited Haugesund, the 18,000 GT North Sea Giant was doing sea trials with EBLs installed after undergoing a retrofit for its six, 5 MW engines, its DP3 with variable-speed drive and three hybridizing systems onboard that can deliver



full ship power on one engine, if needed.

Like an offshore wind-turbine installation vessel or cable layer, the Giant needed redundancy. Tighter energy management rules demanded efficiency, hence the three DC hubs and EBLs installed for battery loops. An auxiliary generator added the variable speed. "It's a gamechanger for running on a single engine (or DP 3 only)," said Cato Espero, Wärtsilä head of sales for Scandinavia. He adds that the North Sea Giant will cut two million liters per year of fuel costs for its owners, about as much as 2,000 cars per year. Its six engines can run as three, and its three battery packs are similar to the Fred Olsen wind-carrier jack-up vessel. "An electrical bus switch for their vessel cut the cost of operations and of fuel by 50 percent and allows its three different hybrid systems to work as one."



Above:
Optimal outputs: a wind-turbine permanent magnet generator at The Switch in Deyang.

Left:
Dual-use: A marine permanent magnet motor from The Switch.

In Norway, of course, government does offer funds for conversions to greener power, and so owners are not paying the full cost. It's a national drive, and "Shipowners say the ships should be easy to convert to new fuel," said Parpala.

China offering

While all of The Switch's current customers for vessel-drive conversions are Norwegians, customers buying the company's converters for wind turbines are largely Chinese and Danish. Their Chinese plants produce components for Chinese land-

Image Courtesy Yaskawa's The Switch

China challenge:
The Switch presence in China includes this site in Luan.

based wind turbines. The hope is to also get them buying drives for wind-service vessels and offshore wind turbines.

"The Chinese move fast to adopt new technology," Parpala asserts, a confident nod to ramping up the Chinese wind energy value chain. "Since the start of our company in 2006, we have delivered 6,000 converters in China for onshore turbines. One of our key Chinese customers also has our converters offshore," he says, adding, "but we have not yet produced any equipment for marine."

The Switch had local manufacturing at several locations in China before the outfit was acquired by Yaskawa. In Hangzhou, The Switch's people work with Finland-based contract manufacturer and system supplier, Scanfil, where they make full-power converters for wind. A factory in Lu'an makes converter components. Beijing and Hong Kong host The Switch sales and after-sales support offices.

Asked if floating wind farms like HyWind posed a different challenge, Parpala says, "Generally speaking, it doesn't matter if (they're) floating or fixed foundations, there is not much difference when it comes to the generator design. Some of our customers do have floating projects."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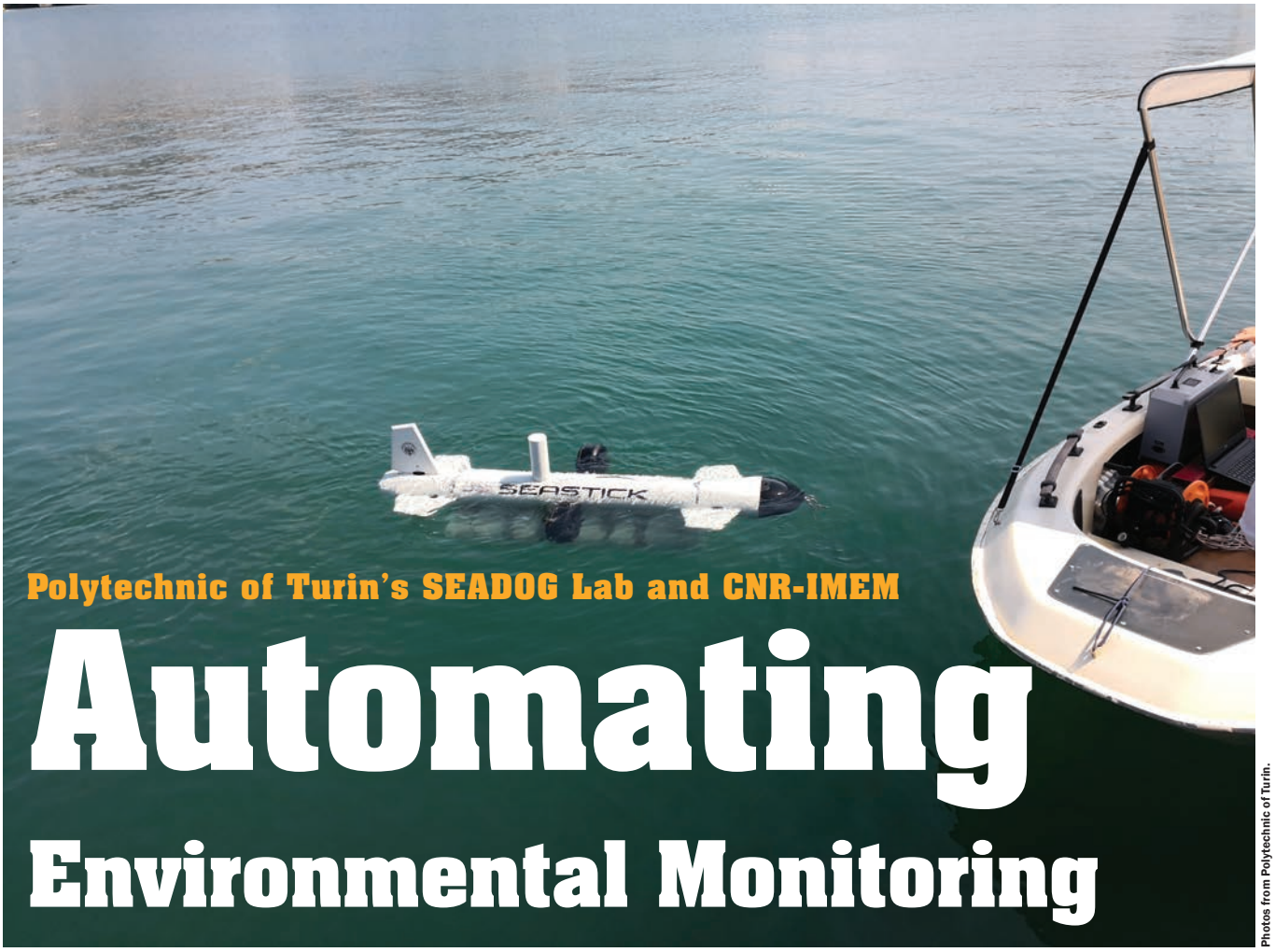


Photos from Polytechnic of Turin.

Polytechnic of Turin's SEADOG Lab and CNR-IMEM

Automating Environmental Monitoring

Researchers in Italy are tackling how to monitor, continuously and over wide areas, for harmful metal compounds in our seas and oceans around human activity.

By Elaine Maslin

Detecting trace metals in our seas and oceans using lab-on-a-chip technologies on autonomous underwater vehicles (AUVs) has been made possible through a research project in Italy.

Researchers at the Polytechnic of Turin's SEADOG Lab and CNR-IMEM (the Italian national research institute's Institute of materials for electronics and magnetism) have trialed a prototype of the technology on an AUV near Genoa Port, where data collection and wireless transmission to shore was demonstrated.

Monica Periolatto, from the Polytechnic of Turin, outlined the Italian Ministry of Economic Development funded project at the Offshore Mediterranean Conference (OMC) earlier this year. She said the project's focus was on detecting trace heavy metals in the sea or ocean, such as chromium-6, which has been found in drilling waste, as well as zinc, copper and nickel, which can be harmful to the ecosystem.

"Continuous on-site monitoring of these activities is essential," she says. But, "Just now, (sample) analysis has to be done in a laboratory onshore. This means a delay in sampling and it's impossible to do continuous monitoring. We looked at the lab-on-a-chip (microfluidic analysis) and how to embed this into the payload of a submarine drone so that it can monitor large areas of interest and provide results in a continuous way and in real-time."

Various methods of sampling and testing are used, including spectroscopic analysis and neutron activation analysis, but these cannot be easily miniaturized and put in a portable

> **"Continuous on-site monitoring of these activities is essential. But, Just now, (sample) analysis has to be done in a laboratory onshore. This means a delay in sampling and it's impossible to do continuous monitoring. We looked at the lab-on-a-chip (microfluidic analysis) and how to embed this into the payload of a submarine drone so that it can monitor large areas of interest and provide results in a continuous way and in real-time."**
>
> **Monica Periolatto, Polytechnic of Turin**

device such as an AUV, says Periolatto. They also need energy sources and pre-treatment of the samples for analysis. The most common method for chromium detection in water samples close to oil and gas facilities is diphenycarbazide (DFC) absorption. DFC involves a reaction which creates a color detectable using a UV-visible spectrophotometer.

But, today, this is done periodically, samples analyzed in laboratories and the discrete nature of the sampling doesn't allow for mapping containment plumes or establishing a correlation between contaminants and a source. "A more refined environmental monitoring system" is needed, that can perform real-time mapping of water quality near offshore platforms using AUVs, Periolatto says.

The group from the SEADOG Lab and CNR-IMEM chose to adapt the DFC absorption technique for use with microfluidic technologies (eg. lab-on-a-chip), to manage samples

The Seastick 300 AUV, from Gabri, of Genoa, loaded with SEADOG's lab on a chip.

Photos from Polytechnic of Turin.

and enable in-situ analysis of marine water samples. Using microfluidic analysis means smaller samples for analysis are needed and therefore less and weaker reagent, enabling longer duration monitoring missions, in turn allowing greater areas to be covered.

First, the group set out to optimize the way samples are analyzed and the laser source (different sources were used for chromium and zinc detection) for the spectrophotometric analysis. This in fact resulted in a much simpler process than was previously used, says Periolatto. The work also tested what the system could detect, to make sure it would be fit for purpose. Using the lab-on-a-chip technology meant the sample size required was just 1ml, which is enough for measurement to a detection of 5 ppb for chromium. "The amount of treated sample traditionally put in the cuvette is 5-10ml, but it requires the treatment of at least 50-100ml of sample," Periolatto told *MTR*. The lab on a chip developed was 150mm-long, allowing an optical path of 100mm to detect metal concentrations of few ppb, and 80mm width, that is four channels with diameter 2mm each. The whole apparatus for sampling, sample treatment, degasing and waste discharge is fixed on a plate measuring 100mm by 330mm.

The automatic microfluid system, which requires just 5Wh, was then integrated into a 300m depth rated Seastick 300 AUV, from Gabri, Genoa, with wireless control and data transfer, to prove mechanical robustness of the system and communications capability during trials out of Genoa port in July 2018. The next stages are more robust testing on the automatic prototype, including more extensive testing with real water samples.

More could also be done with this device, says Periolatto. Integrating the laser source and detection technologies, a microfluidic system to collect the samples and filter them, and using microelectronic systems, meant an otherwise laboratory-based process could be packed into a cylinder for integration on to an AUV. "We are planning to investigate other metals detection but also other contaminants such as nanoplastics or aromatic compounds," she told OE.

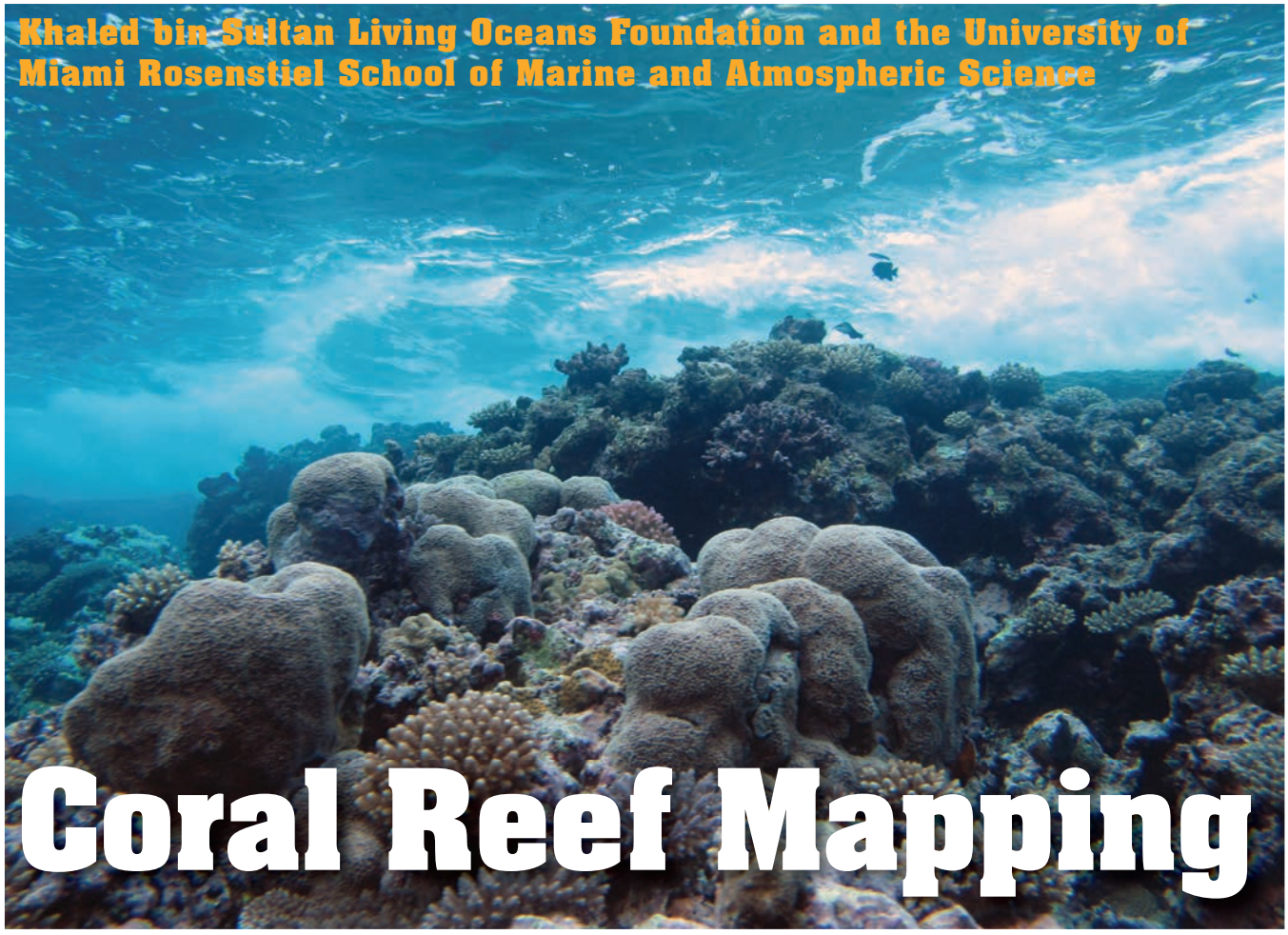
Using different chambers in the microfluid system can also mean that different materials analysis could be done, says Periolatto. By building the device in a modular way, as well as automating the process, this means the choice of metal being detected could be controlled via remote control using the vehicle's onboard wireless communication.

The project was also supported by the Italian Direzione Generale per la Sicurezza anche ambientale delle attività minerarie ed energetiche (DGS UNIMG), del Ministero dello Sviluppo Economico (MISE) as well as Microla Optoelectonics and CEMAS Elettra, for help on the prototype development and realization. As well as Periolatto, Prof. Fabrizio Pirri, Prof. Luciano Scaltrito and Prof. Sergio Ferrero and Ing. Felice Catania were involved in the project.

Trials in Genoa port, last July.

Photos from Polytechnic of Turin.

Khaled bin Sultan Living Oceans Foundation and the University of Miami Rosenstiel School of Marine and Atmospheric Science



Coral Reef Mapping

Photo credit: Khaled bin Sultan Living Oceans Foundation

This first-ever global coral reef atlas contains maps of over 25,097 sq. miles of coral reefs and surrounding habitats, making it the largest collection of high-resolution coral reef maps ever made.

A study from scientists at the Khaled bin Sultan Living Oceans Foundation and the University of Miami Rosenstiel School of Marine and Atmospheric Science offers a new way to accurately map coral reefs using a combination of Earth-orbiting satellites and field observations. The maps, published recently in the journal Coral Reefs, are the result of a 10-year Global Reef Expedition by scientists for the Khaled bin Sultan Living Oceans Foundation. The expedition traveled to more than 1,000 remote coral reefs in 15 countries, mapping and surveying the reefs down to a one-square meter scale to better understand their health and resiliency, many of the reefs studied for the first time. The high-resolution coral reef maps contain detailed information on the location and depth of different parts of the coral reef (such as the reef crest, fore reef, back reef, and lagoonal reef) visited on the expedition, as well as information on the size of seagrass beds and mangrove forests along the coast. All of these coastal habitats are key components of tropical coastal ecosystems and help to filter water, protect the coast from storms, and provide nursery habitat for commercial and subsistence fisheries. They also face increasing threats from coastal development, overfishing, and climate change.

To develop the new model to accurately map coral reef and other tropical shallow-water marine habitats, scientists took data collected from extensive SCUBA surveys conducted on the Global Reef Expedition and extrapolated that information across the entire reef using ultra-high-resolution satellite imagery. By comparing the maps with video footage from cameras dropped at precise coordinates along the reef, scientists were able to verify the accuracy of their new mapping method.

"In order to conserve something, it's imperative to know where it is located and how much of it you have," said Sam Purkis, a Professor and Chair of the UM Rosenstiel School Department of Marine Geosciences. "Developing such an

understanding for coral reefs is especially challenging because they are submerged underwater and therefore obscured from casual view. With this study, we demonstrate the potential to use satellite images to make coral reef maps at a global scale."

Scientists now have a way to peer beneath the waves to accurately map large areas of coral reefs at greatly reduced cost. Traditional coral reef surveys are expensive to conduct and limited in scope, requiring hours of underwater surveys conducted by highly-trained scientific divers. Using this new model, scientists can create detailed coral reef habitat maps without having to survey the entire reef in person.

"Satellite, aircraft, and drone imaging will become an increasingly important tool for addressing the coral reef crisis at the global scale at which it's occurring," said Purkis, who is also Interim Chief Scientist at the Living Oceans Foundation.The high-resolution coral reef maps made for this study can be found on the World Reef Map, an interactive coral reef atlas where users can explore all of the coral reefs and shallow water marine habitats mapped on the Global Reef Expedition.

Although they by no means cover every reef worldwide, this new atlas covers a meaningful portion of key reef provinces around the world. It also provides much-needed baseline data of coral reef health prior to the 2017 mass bleaching event. This digital resource has been made available to the public so that governments and conservation organizations can use these maps to protect and restore their coral reefs for generations to come.

Scientists estimate that more than 50 percent of coral reefs worldwide have been lost in the past 40 years due to climate change and other human pressures. These new detailed habitat maps can help local resource managers identify areas that may be in greatest need of conservation action.

"Benthic habitat maps are an essential tool in coral reef conservation as they provide a snapshot of where reefs are located and the status of their health," said Alexandra Dempsey, the director of science management for the Khaled bin Sultan Living Oceans Foundation and a co-author of the paper. "Scientists will use these habitat maps as baseline data to help track changes in reef composition and structure over time."

All images photo credit: Khaled bin Sultan Living Oceans Foundation

The Study:

"High-resolution habitat and bathymetry maps for 65,000 sq. km of Earth's remotest coral reefs," was published online on April 18, 2019 in the journal Coral Reefs, DOI: https://doi.org/10.1007/s00338-019-01802-y. The study's authors include: Sam Purkis, Alexandra Dempsey, Mohamed Faisal, and Philip Renaud of the Khaled bin Sultan Living Oceans Foundation; Sam Purkis Arthur Gleason of the UM Rosenstiel School; Charlotte Purkis of Sea from Space Inc; Steven Saul of Arizona State University and Jeremy M. Kerr of Nova Southeastern University.

Marine Institute of Memorial University of Newfoundland

At the Forefront of Ocean Technology

Photo: Tom Mulligan

World-class facilities, research and education at the Fisheries and Marine Institute of Memorial University of Newfoundland

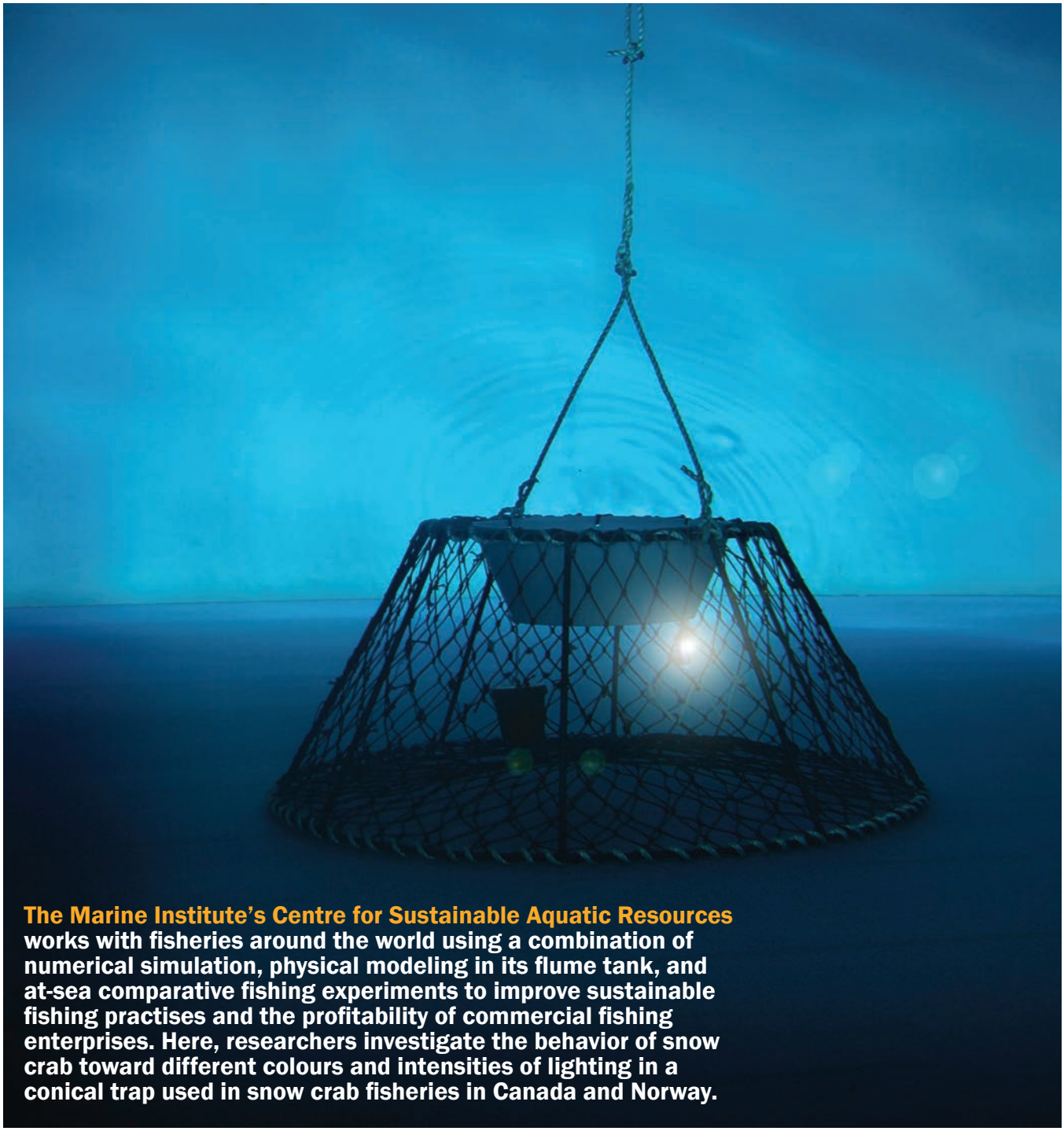
By Tom Mulligan

The Marine Institute or, to give it its full title, the Fisheries and Marine Institute of Memorial University of Newfoundland, located in St John's, Newfoundland is dedicated to education, training, applied research and industrial support for the ocean industries and is one of the most respected centers of marine learning and applied research in the world, providing more than 20 industry-driven programs with awards ranging from technical certificates to master's degrees. In addition to its undergraduate and graduate programs, the Institute also offers advanced diplomas, diplomas of technology and technical certificates and runs a number of short courses and industrial response programs that are designed to provide students with the knowledge and skills they require for success in the marine industry workforce. The Institute runs three marine sector Schools – the School of Fisheries, the School of Maritime Studies, and the School of Ocean Technology, each of which includes a number of specialized marine sector centers and units that lead the Institute, both nationally and internationally, in applied research and technology transfer and in the provision of training to a range of types of industry client.

School of Fisheries

The School of Fisheries delivers education and training programs to students interested in entering the aquaculture, fishing, environmental and food industries, and offers academic

Icebreaker design research is carried out in the ice tank at the Marine Institute, St John's, Newfoundland.



The Marine Institute's Centre for Sustainable Aquatic Resources works with fisheries around the world using a combination of numerical simulation, physical modeling in its flume tank, and at-sea comparative fishing experiments to improve sustainable fishing practises and the profitability of commercial fishing enterprises. Here, researchers investigate the behavior of snow crab toward different colours and intensities of lighting in a conical trap used in snow crab fisheries in Canada and Norway.

Photo: Fisheries and Marine Institute of Memorial University of Newfoundland

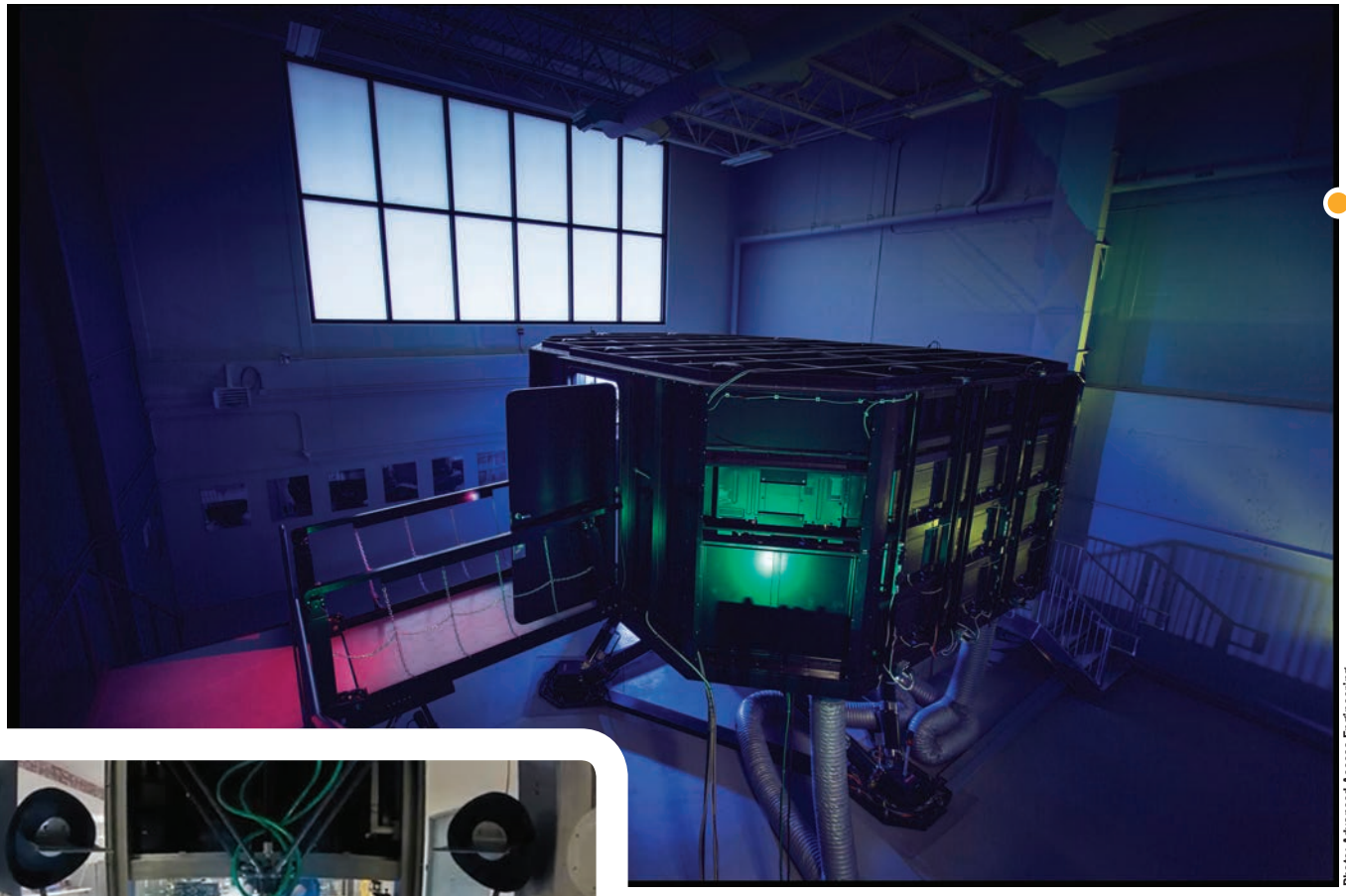
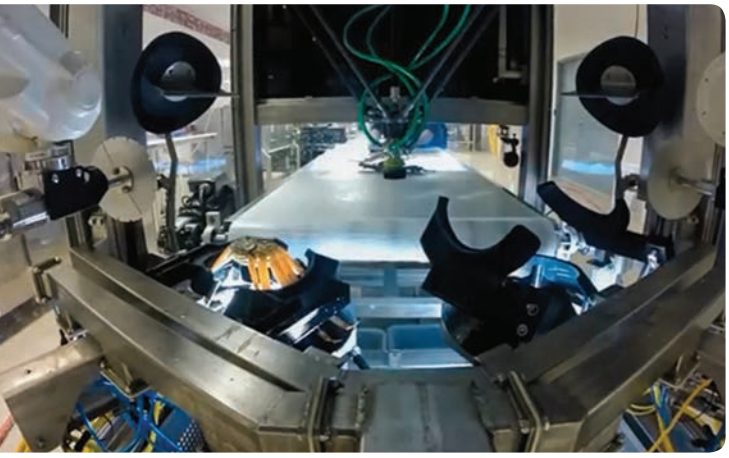


Photo: Advanced Access Engineering



Photos: Fisheries and Marine Institute of Memorial University of Newfoundland

Above: This 'smart' butchering technology robotic system for butchering crab represents the first use of robotics for processing crab anywhere in the world and is currently undergoing a patenting process.

Right: Featuring extensive marine facilities in Holyrood, Newfoundland, The Marine Institute's marine base houses its Centre for Applied Ocean Technology, and provides a safe, reliable, near-Arctic environment to test new technology.

The Marine Institute's Centre for Marine Simulation offers high-fidelity, state-of-the-art technology, 360-degree visuals, and motion systems. The Centre can replicate specialized oil and gas operations including anchor handling on the Hibernia Offshore Operations Simulator.

programs that range from industry certifications to diplomas of technology, joint diploma/bachelor degrees, advanced diplomas, post-graduate certificates and master's degrees. The School also has significant involvement in community-based training programs in which instructors teach short industry training programs in communities, primarily in Newfoundland and Labrador and northern Canada, and is currently planning to offer more online courses and programs.

The four industrial research and training units run by the School of Fisheries are the Centre for Aquaculture and Seafood Development (CASD); the Centre for Fisheries Ecosystem Research (CFER); the Centre for Sustainable Aquatic Resources (CSAR); and Community Based Education Delivery (CBED).

School of Maritime Studies

The School of Maritime Studies at the Marine Institute provides training and certification programs that qualify mariners in the design, operation and management of ships for the transportation of materials and products across the oceans. Such training and certification has become highly regulated, and the School of Maritime Studies works closely with the relevant Canadian and international authorities to ensure that its programs meet or exceed the required standards.

The School provides education and training in the design of ships and associated systems, its programs preparing individuals for entry-level operational positions as deck officers, engineering officers and ratings. In addition, the School's Bachelor of Maritime Studies and Master of Maritime Management degrees are designed for those who wish to enhance their knowledge and skills to prepare themselves for other positions in the marine industry.

The School also works closely with industry to provide short courses to meet both mandatory and non-mandatory training needs through its Industrial Response Program and many of the courses in the program can be presented off campus at locations convenient to a client's area of operation. The School also operates three major centers within its facilities: the Centre For Marine Simulation (CMS); the Offshore Safety and Survival Centre (OSSC); and the Safety and Emergency Response Training Centre (SERT).

School of Ocean Technology

With a growing human population placing increasing burdens on resources and the environment, the application of ocean technology is of particular interest in reducing such burdens because of the pivotal role the oceans play in all aspects of human existence: this includes their influence on commerce, sustenance and climate, and the Marine Institute's School of Ocean Technology is charged with the responsibility of developing and delivering education and training and applied research and development programs in this field by developing and delivering education and training programs to meet the needs of the ocean sector (industry, academia and government) in Canada and beyond.

Education and training programs offered by the School of Ocean Technology include diplomas and degrees in ROV technology; underwater vehicle technology; ocean mapping; and technology management; while in addition to offering education and training, the School undertakes applied research and development in four key areas: ocean instrumentation, underwater vehicles, ocean mapping and ocean observing systems, the work being undertaken through the Centre for Applied Ocean Technology.

Responding to evolving technology needs

The School says the guiding principles of its applied research and development effort are to respond to the evolving technology needs of key ocean industries such as fisheries, shipping, offshore oil and gas and provide work experience and employment opportunities for students and graduates of its programs. To develop and deliver its ocean technology education and training and applied research and development, the School works collaboratively with the expertise and facilities found throughout the Marine Institute, including with the acoustics tank, a rectangular concrete water tank four meters deep, four meters wide, and 5.5 meters long containing 88,000 liters of water, used for transducer development, materials, and flow noise studies in addition to structural acoustics; the world's largest flume tank, which is used to carry out performance evaluations, gear tests and other observations on newly developed or existing fishing gears and other related equipment in simulated underwater and near-surface conditions; a number of cameras available for underwater video collection for both field work and tank projects; and a range of small work-class remotely operated vehicles (ROV) used for training and observation purposes.

www.mi.mun.ca

Silicon Sensing's All-Silicon Gyro

In trials of its latest pilot's aid, the ADX XR, AD Navigation AS has used Silicon Sensing's new, MEMS gyroscope, the CRH02, to help guide the 'Pioneering Spirit' into Maasvlakte in the port of Rotterdam.

The Pioneering Spirit was formerly Pieter Schelte and, at a massive 372 x 124 meters, is the largest construction vessel in the world. The vessel is designed for the single-lift installation and removal of large oil and gas platforms and the installation of record-weight pipelines.

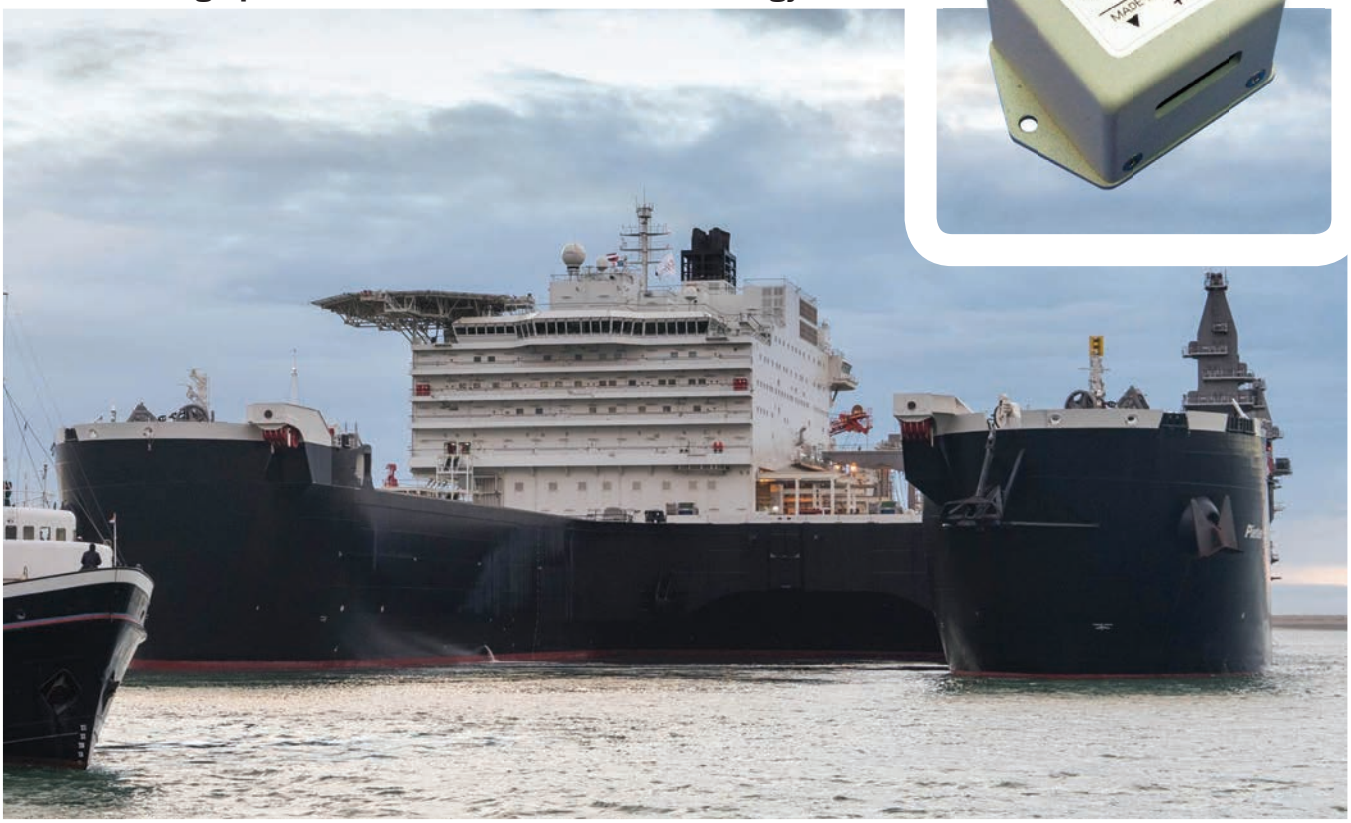
In maneuvering and docking such large vessels in the close confines of port a pilot will, typically, take control. In this trial, the pilot used the ADX XR to aid the difficult navigation process. The extremely precise data on ship movement that the CRH02 consistently delivered allowed the ADX XR to maintain a highly accurate and detailed 3 to 5-minute ship course prediction for the pilot throughout all maneuvers and docking.

Silicon Sensing's CRH02 is an all-silicon single axis gyro measuring just 25mm square and 33mm high and weighing only 45 grams. This tiny unit delivers the outstanding motion sensing performance typical of much larger fiber optic gyro (FOG) devices - but is far more robust, with a much lower size and weight. AD Navigation's ultra-precise, portable navigation systems require this level of performance as they help manage the traffic in major ports like Rotterdam, Antwerp, London and Liverpool and are also used by the US Navy for maneuvering naval vessels to a precision of only a few centimeters. Size and weight are also key as these are portable devices, installed only for the duration of the pilotage. Following this successful trial, a production order was placed for CRH02 gyros for the ADX XR.

Lorentz Ryan, Managing Director of AD Navigation AS explains: "The compact form factor along with the extremely precise performance of the new CRH02 gyro makes it a perfect component in our ADX XR ultra-precise and portable navigation system."

Steve Capers, General Manager, Silicon Sensing Systems comments: "Our team is particularly proud of this successful trial, and the subsequent production order to equip AD Navigation's

The Pioneering Spirit & the new CRH02 silicon MEMS gyro.



Images courtesy Silicon Sensing

latest high-performance pilot's aid. All our devices are based on our patented vibrating ring design which means they can deliver a unique combination of precision performance and robustness – a combination that is particularly appropriate in the tough and ever-changing marine environment."

Silicon Sensing Systems' micro electro-mechanical systems (MEMS) devices are relied on in many maritime roles, including positioning, stabilization and navigation. The business is a joint venture, owned by Collins Aerospace and Sumitomo Precision Products and, after 20 years in operation, has supplied approaching 30 million gyroscopes and accelerometers to thousands of customers. With demand for their devices growing, a new JV agreement has recently been signed which will take the business through its third decade.

Watch it on *MTR TV*!

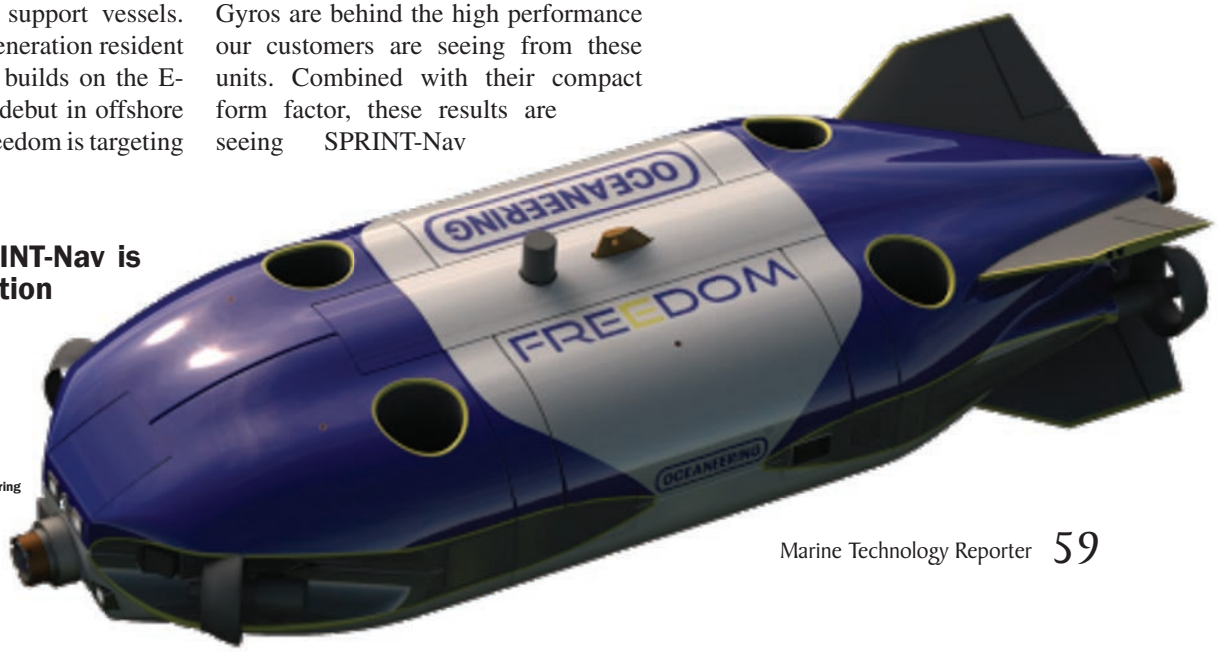
MTR TV spoke with **Andy Hughes, Sales Manager, Silicon Sensing** recently in Southampton, England. https://www.marinetechnologynews.com/videos/video/silicon-sensing-launches-new-technology-100110

Oceaneering 'Resident' Vehicles feature Sonardyne Tech

Oceaneering has ordered hybrid navigation systems from Sonardyne for its subsea resident vehicles Freedom and E-ROV. The two resident vehicle systems are to be fitted with Sonardyne's SPRINT-Nav an all-in-one navigational instrument. SPRINT-Nav combines a SPRINT INS sensor, Syrinx 600 kHz DVL (Doppler velocity log) and a high accuracy intelligent pressure sensor in a single unit. Oceaneering's E-ROV has already proven the ability for battery powered remotely operated vehicles (ROVs) working in the oil and gas industry to be piloted from shore, via 4G mobile broadband transmitted from a buoy, independent of support vessels. The company's next-generation resident hybrid ROV Freedom builds on the E-ROV concept. Due to debut in offshore trials later this year, Freedom is targeting long, maintenance free-deployments, on autonomous missions and with support from shore-based pilots.

The vehicle will be based out of docking stations on the seabed, enabling it to recharge and download data before and after its subsea inspection, maintenance and repair missions. It will operate in tethered and autonomous "tether-less" modes, performing both AUV and ROV related tasks, including survey, inspection, torque tool operation and manipulator-relator activities.

"Tight integration of the separate sensors within SPRINT-Nav as well as the use of high-specification Ring Laser Gyros are behind the high performance our customers are seeing from these units. Combined with their compact form factor, these results are seeing SPRINT-Nav fast becoming the INS instrument of choice for resident vehicles," said Char Franey, Sales Manager for Survey and Construction at Sonardyne in Houston. "They're free from the calibration routines otherwise required and, because they also run on a unique dual engine algorithm, powering the INS and Gyro compass, initialization is fast and gaps in navigation are few and far between. Thanks to these qualities, SPRINT-Nav is not only ideally suited to subsea resident vehicle applications, but also autonomous and unmanned underwater vehicle (AUV/UUV) navigation."



Sonardyne's SPRINT-Nav is the hybrid navigation instrument of choice for subsea resident vehicles for future field operations.

Image: Oceaneering

Horizon IMU to Complete the Navsight Marine Solution

SBG Systems debuted the Horizon IMU, a FOG-based high performance inertial measurement unit (IMU) designed for large hydrographic vessels. Navsight Marine Solution consists in a ready-to-use inertial navigation solution dedicated to hydrographers. It is available at different levels of accuracy to meet the various application requirements and can be connected to various external equipment such as Echosounders, LiDAR, etc. Navsight Marine Solution are currently offered at two levels of performance with the Ekinox and Apogee IMUs. These MEMS-based IMUs address most of hydrographics markets whether shallow or deep water. The new Horizon IMU is designed to allow users to bring the Navsight technology to the most demanding environments such as surveying highly dense as well as applications where only a single antenna can be used. Horizon IMU is based on a closed-loop FOG technology which enables ultra-low bias and noise levels. This technology allows robust and consistent performance even in low dynamics survey.

The Navsight solution is designed to be easy to install, as the sensor alignment and lever arms are automatically estimated and validated. Once connected to the Navsight processing unit, the web interface guides the user to configure the solution. A 3D view of the vessel shows the entered parameters so that the user can check the installation. The Navsight unit also integrates led indicators for satellite availability, RTK corrections, and power. It comes with a rugged enclosure, or in a rack version for larger vessels.

Completing the Navsight offer, Qinertia, the SBG post-processing software, gives access to offline RTK corrections from more than 7,000 base stations located in 164 countries. Trajectory and orientation are then greatly improved by processing inertial data and raw GNSS observables in forward and backward directions. Computation takes less than 3 minutes for a 6-hour log thanks to the Forward and Backward calculation processed at the same time.

www.sbg-systems.com/products/navsight-marine-series/#navsight-marine-horizon-grade

2019 EDITORIAL CALENDAR

MARINE TECHNOLOGY REPORTER 2019 MEDIA KIT

Profile | Market Feature | Technical Feature | Product Feature

JAN/FEB

Ad Close: Dec 21

Underwater Vehicle Annual

- Subsea Defense
- Southern California Cluster
- Autonomous Navigation GNSS MEMS
- Unmanned Vehicle Propulsion

Event Distribution
Oceanology Intl North America
Feb 25- 27, San Diego, CA
Underwater Defense & Security
Mar 5-7 Southampton, UK

FEBRUARY

Ad Close: Jan 22

MTR White Papers: Oceanographic

White Paper Electronic Edition Publication Date: February 2019

MARCH

Ad Close: Feb 21

Oceanographic Instrumentation: Measurement, Process & Analysis

- Ocean Business 2019 Technology Spotlight
- Fiber Optic Cables, Connectors & Slip Rings
- Marine Drones
- Hydrographic Sonar & Software

Ocean Business
April 9-11, Southampton, UK

AUVSI XPONENTIAL
Mar 29- Apr 2 Chicago, IL

APRIL

Ad Close: Mar 21

Ocean Energy: Oil, Wind & Tidal

- Workclass ROV
- Underwater Lights & Cameras
- Buoyancy Technology
- Scientific Deck Machinery / LARS

Event Distribution
Offshore Technology Conference
May 6- 9, Houston, TX
Sea-Air-Space
May 6- 8, National Harbor, MD

MAY

Ad Close: Apr 21

Underwater Defense Technology

- Navy
- Comms, Telemetry & Data Processing
- Magnetometers & Streamers
- Beacons, Flashers & Tracking Systems

Event Distribution
UDT
May 13- 15, Stockholm, Sweden
MAST Asia
June 17-19, Tokyo, Japan

JUNE

Ad Close: May 21

Hydrographic Survey: Single & Multibeam Sonar

- Research Institutions
- USV Platforms
- GPS, Gyro Compasses & MEMS Motion Tracking
- Interconnect: Underwater Cables and Connectors

Event Distribution
Oceans 2019
Jun 17-20, Marseille, France

JULY

Ad Close: Jun 22

MTR White Papers: Hydrographic

White Paper Electronic Edition Publication Date: July 2019

JULY/AUGUST

Ad Close: Jul 21

MTR 100 - Edition

The 14th Annual Listing of 100 Leading Subsea Companies

MTR looks at 100 leading companies and executives in all subsea disciplines, defense, offshore energy and science.

Event Distribution
Offshore Europe
Sep 3- 6, Aberdeen, UK
Seatrade Offshore Marine & Workboats
Sep 23-25 Abu Dhabi, UAE

SEPTEMBER

Ad Close: Aug21

Autonomous Vehicle Operations

- Subsea Engineering: Subsea Field Architecture
- ROV Technology: Work Class to Micro Systems
- Thruster Tech: Underwater Propulsion
- Underwater Tools & Manipulators

OCTOBER

Ad Close: Sep 21

Ocean Observation: Gliders, Buoys & Sub-Surface Networks

- Instrumentation: Profilers, Samplers & Sediment Corers
- Research Vessels
- Harsh Environment Systems for Arctic Ops
- Geospatial Software Systems for Hydrography

Event Distribution
Oceans 2019 Oct 28-31 Seattle, WA

Clean Gulf
Nov 2- 5, Houston, TX

Blue Tech Week
San Diego, CA

NOVEMBER

Ad Close: Oct 22

MTR White Papers: Subsea Vehicles

White Paper Electronic Edition Publication Date: November 2019

NOVEMBER/DECEMBER

Ad Close: Nov 21

Acoustic Doppler Sonar Technologies ADCPs and DVLs

- Fresh Water Monitoring & Sensors
- Offshore Inspection, Maintenance & Repair (IMR)
- Underwater Imaging: Lights, Cameras & Sonars
- The 2020 Subsea Market Planner

Event Distribution
Surface Navy Association 2020
Crystal City, VA
Underwater Intervention 2020

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Maritime Propulsion	21,803
Maritime Reporter & Engineering News	62,329
World Energy News	48,236

All stats from 01/23/2019

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31	RTSys	www.rtsys.eu/en	+33 (0) 297 898 580
3,13	SBG Systems	www.sbg-systems.com	Please visit us online
C4	Shark Marine Technologies, Inc.	www.sharkmarine.com	(905) 687-6672
21	Silicon Sensing Systems Limited	www.siliconsensing.com	+44 (0) 1752 723368
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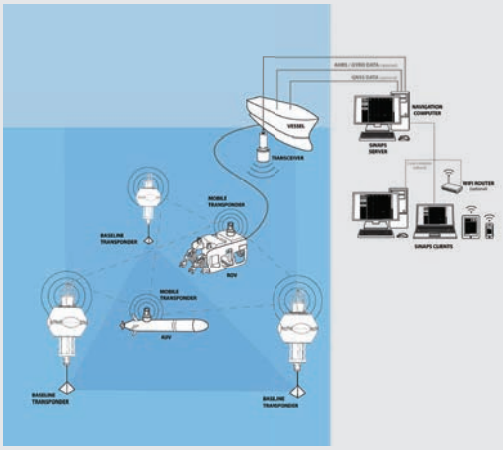

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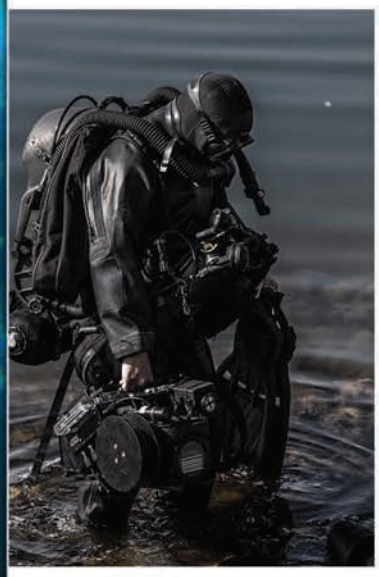

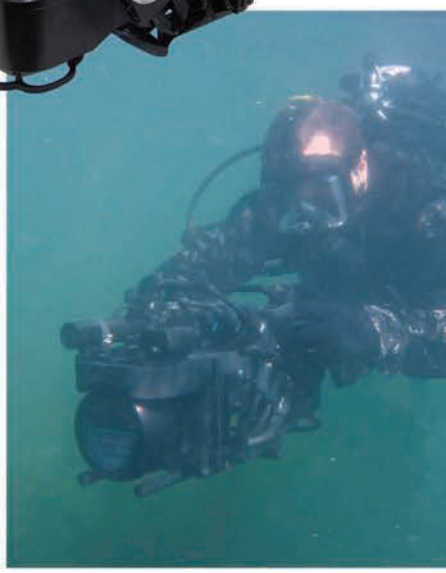

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