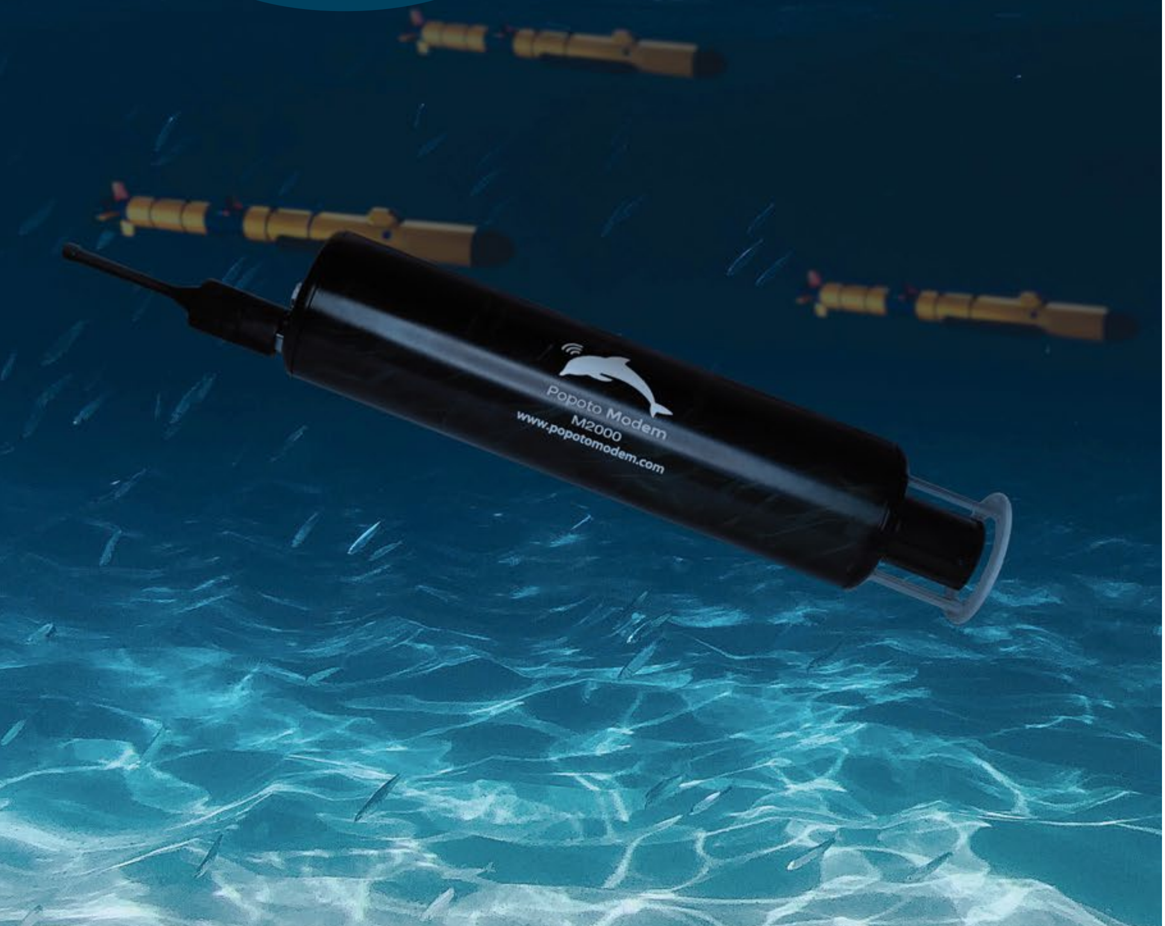
ROV PLANET



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The magazine of choice for Marine & Underwater Robotics focused Professionals

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EVENTS CALENDAR

For more information about all events visit WWW.ROVPLANET.COM

SEPTEMBER 2021

SPE OFFSHORE EUROPE
Aberdeen, UK (7–10 September 2021)

DSEI
London, UK (14-17 September 2021)

MTS/IEEE OCEANS'21 SAN DIEGO - PORTO
San Diego, CA, USA (20–23 September 2021)

OCTOBER 2021

OCEAN BUSINESS
Southampton, UK (12–14 October 2021)

OFFSHORE ENERGY
Amsterdam, The Netherlands (26–27 October 2021)

NOVEMBER 2021

MARINE AUTONOMY TECHNOLOGY SHOWCASE (MATS)
Southampton, UK (9-11 November 2021)

WINDEUROPE – ELECTRIC CITY
Copenhagen, Denmark (23-25 November 2021)

DECEMBER 2022

UNDERSEA DEFENCE TECHNOLOGY (UDT)
Rostock, Germany (14-16 December 2021)

FEBRUARY 2022

SUBSEA EXPO
Aberdeen, Scotland, UK (22–24 February 2022)

MARCH 2022

OCEANOLOGY INTERNATIONAL
London, UK (15–17 March 2022)

My name is Richie Enzmann, and allow me to welcome you all to the latest issue of ROV Planet!

WELCOME TO ROVPLANET!

Dear Reader,

In this issue we have interviews related to two major anniversaries. The first one is with Mike Jones, the Chairman of SMD, where we talk about the past 50 years of SMD, and their legacy in underwater robotics. The company was started up as a consultancy 50 years ago to grow into a 400+ employee company and world-renowned experts in underwater trenching and robotics. The other interview is with Habia Cables from Sweden who are celebrating their 80th anniversary. Not many companies last that long, so it's great to see major anniversaries like that in our industry!

We have an article of the ISURUS ROV from Oceaneering that was designed specifically for working on renewable energy projects. This ROV can withstand severe tidal currents. Since its launch in 2019, the vehicle has demonstrated its ability to improve economics for offshore renewables projects by expanding the operating currents and vehicle speeds beyond those in which traditional work class ROVs typically work.

Also, Deep Trekker introduced a new ROV into the market: the Pivot. This ROV is slightly bigger than the company's previous range of mini-ROVs. It's great to see Deep Trekker doing well and becoming a manufacturer or several types of ROVs. They are a very talented and innovative company from Canada run by Sam MacDonald and Jeff Lotz.

Staying in Canada, we look back into the past at the first ever Canadian AUV, the ARCS. Bruce Butler was kind enough to write up a piece for us about the development of this iconic AUV that he has previously worked on. From large AUVs we go to uAUVs. RYTSYS are making waves in this field and are rapidly growing as a company, primarily focusing on the defence sector.

We also take a look at the first part of the OCEANS2020 Naval exercise that was held in the Med. The focus of the exercise was to improve the interoperability between manned and unmanned systems, and the lessons learnt will shape future military structures in view of the use of advanced unmanned systems.

Finally, after a long 18 months of Covid lockdowns and restrictions, we are looking forward to meeting some of you at events in Q3 that are planned to go ahead face-to-face!

Best regards,
Richie Enzmann


OCEANEERING®
Connecting What's Needed with What's Next™
OPENING NEW
OPERATING WINDOWS
The Isurus™ ROV enables operations in high current conditions, increasing your working time for offshore renewables projects up to six additional hours.
Connect with what's next at oceaneering.com/isurus
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THE FUTURE OF UNDERWATER INSPECTION

Saipem has been pushing technological boundaries
in the energy industry for over 60 years.

Today, we are at the forefront of underwater life-of-field solutions
and are making the history of subsea robotics.

Our revolutionary FlatFish is an advanced underwater drone
able to autonomously perform complex inspections
of subsea assets in the entire underwater domain,
thanks to its integrated artificial intelligence,
advanced navigation features and payload-based modularity.

CONNECTING THE OCEANS WITH THE POPOTO MODEM

Richie Enzmann, ROV Planet

Until recently underwater connectivity was characterised by expensive modems. However, Popoto Modem offers an alternative low-cost solution for applications that were previously unthinkable because of high costs. With this important piece of the puzzle solved – to enable low-cost underwater communication between any subsea kit – a truly connected underwater internet of things (IoT) is more likely to become a reality than ever before.

In the following paragraphs there are case studies of several different applications where the Popoto Modem has provided the essential link to enable their success. These applications span from defence such as mine countermeasures to aquaculture, demonstrating a variety of potential uses for underwater communications.

Popoto Modem (Courtesy of delResearch)

MINE COUNTERMEASURES AND AUV SWARMING

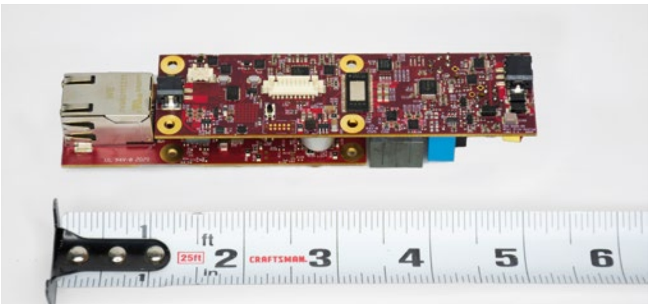
Mission Systems is a robotics company based in Australia founded by David Battle and David Johnson in 2017. Previously, David Battle worked at MIT and later in the Australian Department of Defence on various AUV and mine countermeasure applications over the last 20 years, while David Johnson was defence research lead at the University of Sydney.

Some of Mission Systems work is funded by the Australian Department of Defence, and they're working on a device that can be placed close to an underwater mine to emulate targets such as ships. The idea is that one can command the device to generate signatures of ships and thus detonate the mine. In this case they were looking at a completely expendable design: not interested in building an expensive technology, but a minimal type of hardware implementation.

Popoto Modem (Courtesy of delResearch)

The Popoto modem is one of the more economical modems on the market. It's certainly a lot cheaper than some of the big names, and it supports a lot of the functionality that some of the bigger brands are only now starting to adopt, for example JANUS compatibility. That was important for Mission Systems because they're ultimately targeting defence customers and the emergence of the JANUS, and NATO STANAG standards mean that their products could sell to wider audiences and achieve interoperability with other products. While the Popoto Modem supports JANUS, the user isn't locked into that system. One of the nice things about the modem is that it supports a range of modulation schemes and protocols, each faster than the other. The fall-back is JANUS is considered to be the base mode. But JANUS is completely optional.

What they liked about Popoto technology was that the OEM boards were very compact and very easy to integrate, because of the number of interfaces supporting both serial and Ethernet and having a wide voltage range. Thus, it made it easy for them to incorporate into the Mission Systems products.



Popoto Modem (Courtesy of delResearch)

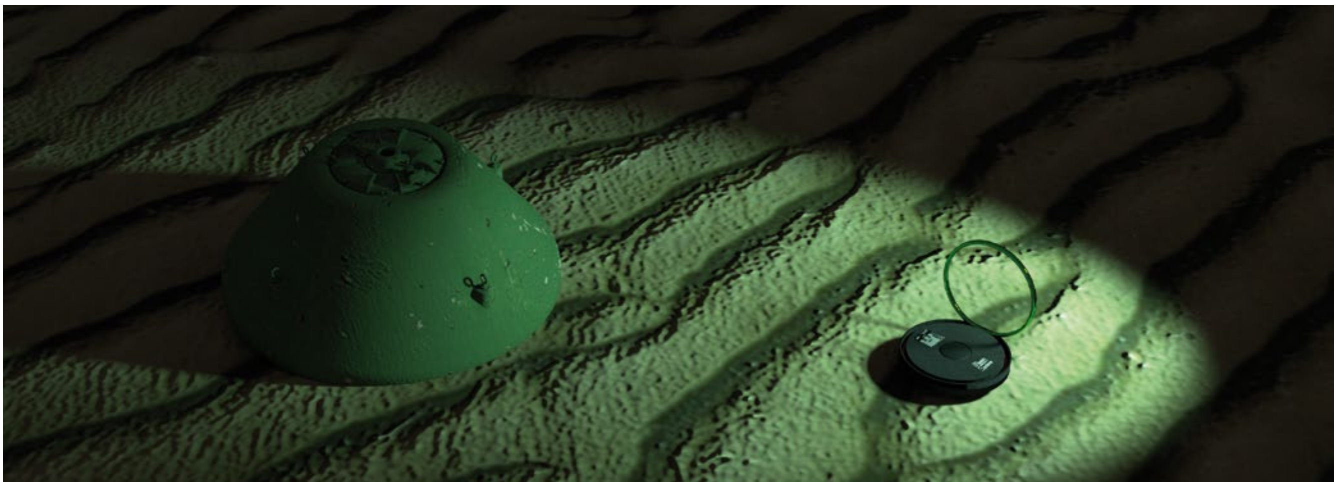
The first thing Mission Systems did was to build the Popoto Mini modem into a "bottom node". The company have a subsea vehicle package that is not exactly an AUV, but the idea is that the package is deployed near the mine. They have the capability to deploy these packages within a few meters of a mine.

Here another great feature of the Popoto Modems comes in handy, which is their low power sleep mode. Mission Systems have used this and tested it in the field. The user can deploy a package on the bottom of the seabed, leave it there for a month, and then return to wake the modem up. They're able to connect the modem to their processor module so that when the modem is sent to sleep the entire system goes with it, so very little power is being consumed. And simply by sending a wake-up tone or tones to the modem, the whole system is reactivated. The processor has this feature where they can supply this sleep signal, thereby sending it to or bringing it out of sleep. This is really valuable because defence staff often want to deploy things in advance and leave them for a long time. If you're looking to deploy a payload which is persistent and it has to last, it's nice to have that capability to put things into a low power mode.

The other handy thing for mine countermeasures and using underwater vehicles is that the Popoto Modem has a built-in ranging capability, so it can be used as a poor man's LBL or USBL system. Popoto implements an accurate two way ranging – it's basically a transmitter ranging pulse – and then the receiver responds. By calculating the total time, you're able to figure out how far away the receiver is.

The Popoto Modem is based on a recent "system on a chip" that makes it power efficient. Running Linux – which is always good – it incorporates a Python interface so it's very easy to use out of the box. Mission systems write their own software on top of the GobySoft middleware which provides DCCL (Dynamic Compact Control Language). The Popoto Modem supports binary message packets, allowing the integrators to encode their messages and compress them down to the minimum size to actually transmit them using the binary protocol. This is much more efficient than sending uncompressed messages.

Initially, Mission Systems also built a test bed for the modem. It wasn't the same size or shape as their prototypes, but it was designed to allow them to do performance tests easily with what was then a new piece of equipment. They took it out and pretty quickly got communications through a couple of



The Micro-Influence Generator (MIG) patented by Mission Systems is a small expendable electronics package equipped with an integrated Popoto acoustic modem. When deployed in close proximity to a bottom influence mine, it can use a variety of signature emulation strategies to actuate or jam the mine's targeting system under remote control. (Courtesy of Mission Systems) kilometres in shallow water. This showed a pretty good performance, and their test bed was big enough to include a large battery, so they could run for weeks without at low power mode. It was a very successful test of the modem and the system.

Mission Systems are also involved with other projects that are funded by the Australian Government. There is one that involves many universities and is led by Thales. This project is looking at interoperability between the different types of equipment and involves swarms of AUVs. The idea is that the swarms are comprised of very small underwater vehicles that may not be expendable but are cheap enough to run en masse (up to 20-30 AUVs). The trouble with having a swarm of AUVs is that communications can get very confusing. So, the other nice feature in the Popoto Modem is the ability to transmit arbitrary waveforms. The system comes with software to generate a range of modulations and message formats, but if for any reason you're not happy with that, you can put your own PCM sampled signal into the modem memory and transmit that instead. This enables the user to come up with all sorts of weird, non-standard messaging protocols, sending time burst at different frequencies, and it means that they can do interesting things with a large number of small vehicles.

Mission Systems have been working with Del Research – the manufacturer of Popoto Modem – for several years now, and they see Popoto Technology being used by the company as their standard platform for the foreseeable future.

About Popoto Modem

What is an Acoustic Modem?

What makes Acoustic Comms Difficult?

LOBSTER RAFT IN THE CONNECTED OCEANS

The North Atlantic Right Whales are on the brink of extinction, and a major threat to them is fishing gear, primarily from the ropes to the surface. These represent entanglement hazards which are difficult for the whales to recover from. Deploying gear without rope is a solution to this big problem. However, it's not easy to throw something out in the ocean and hope it comes back with no rope, but this could very well change soon. Integrating the Popoto Modem into their product, SMELTS – a company based in Washington – have just built a new underwater lifting engine: a new technology and methodology for fishing and recovering ocean gear. The company run by Richard Riels, is helping fishermen to become information towers, since they place enough gear in the ocean that would allow modems to communicate subsea, and maybe back to a surface mooring or a passing ship. The JANUS capability in the Popoto modem enables this interoperability. This connected network for providing information could offer a lot in terms of climatology, ship strike prevention, saving whales, locating wrecks, and more.

Courtesy of SMELTS

Courtesy of SMELTS

The system designed by SMELTS consists of an underwater modem, a surface modem, and an underwater acoustic control valve. The valve is their own magic invention. The system incorporates high pressure gas, whether it be CO_2, air, or nitrogen. Once the Popoto modem relays the signal to actuate the valve under pressure, it will open the high-pressure gas to inflate the lifting bag, and whatever is connected to the system ascends to the surface.

SMELTS have previously deployed ropeless fishing and set hydrophones – underwater listening stations for scientists. They can also recover marine debris or use ROVs to go down and salvage gear. This is a neat new tool in their inventory, different from the mitigated rope tool that most other companies have worked on.


Lobster Raft (Courtesy of SMELTS)


Lobster Raft (Courtesy of SMELTS)

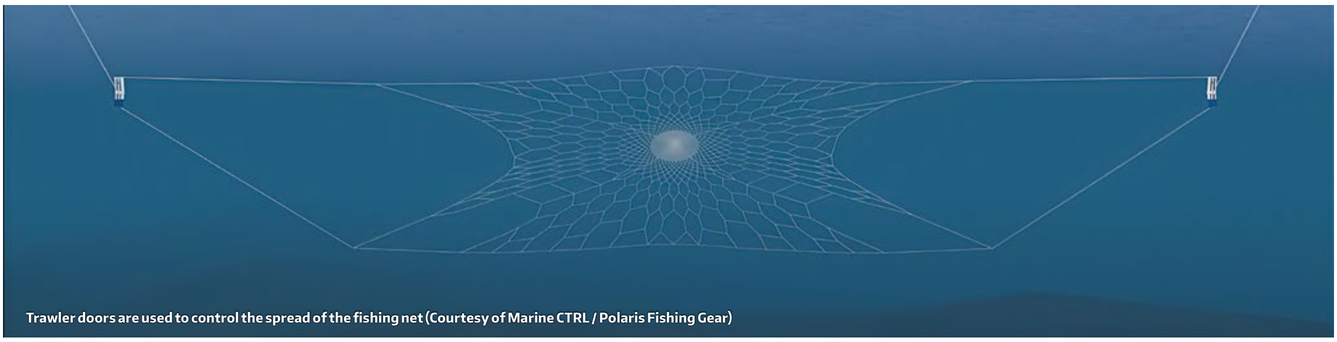

Lobster Raft (Courtesy of SMELTS)

One of the applications connected to the lifting system is a lobster raft. SMELTS decided to purchase all the tools and studied the techniques alongside fishermen to understand how they build lobster cages before making the lobster raft.. It's made from polyethylene and machined to make the components fit into this piece of plastic. When released the wing helps the cage fly down through the ocean. The whole thing is wrapped in lobster cage material, and it's synched together with a special clip gun to make it sturdy, or as they call it, "fishermen tough". There are two technologies that they rely on. One is the acoustics, which allows them to physically tell the cage to come up. The other is a timer. If the gear is lost, after 30 days it will trigger, and the gear will surface automatically.

HIGH TECH FISH TRAWLING

Ulf Lundvall from Marine CTRL is the distributor of the Popoto Modem in the Nordic Countries. He facilitated the purchase of the modems to Polar Fishing Gear, a manufacturer of trawler doors in Iceland. These trawler doors are used to control the spread of the fishing net to enable selective fishing. To get the spread of the net they have two doors to open it horizontally. Then floats on the top and weights on the bottom are used to open the vertical trawl.

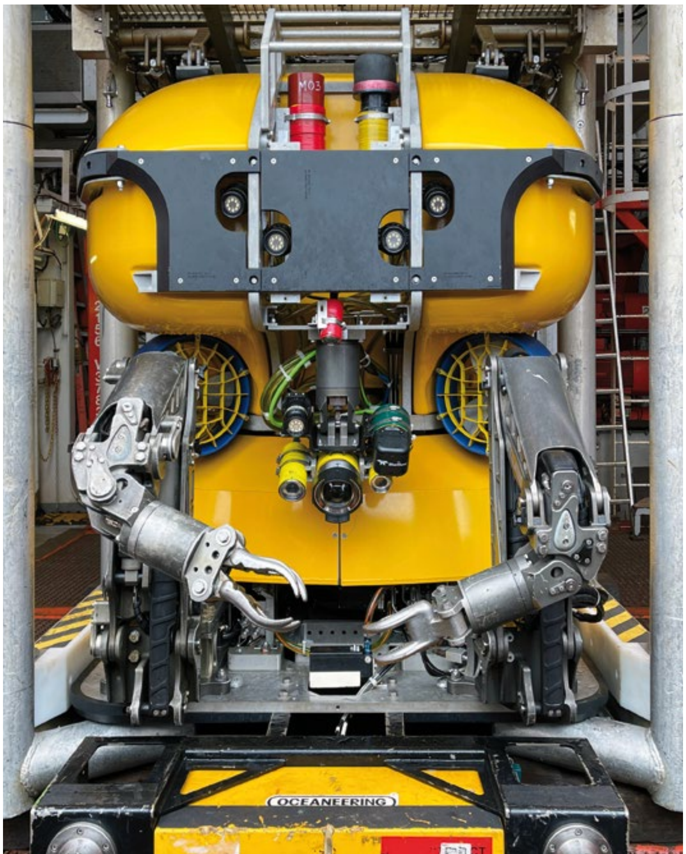
In the old days they used wooden doors, but over the years they've developed more efficient designs. The new thing in the fishing sector is to have controllable, trawlable trawlers that can change the position and orientation of the doors while fishing. For this application you need a modem to control the motors on the doors that are opening or closing hatches or turning foils. At Polar they actually have controllable trawl doors that change the foils. You can also control the angle of the doors: if you angle them inwards, they will lift; if you angle them outwards then they will lower. The pelagic trawler that Popoto Modem was integrated into targets schools of fish like mackerel. If the fishermen see a school of fish on sonar at 300m depths and if the trawl is at 200m, then they must tilt the doors outward to go down and hit their target. In this application the Popoto Modems were used to control the trawler doors wirelessly from the vessel. The control of the doors is more responsive with acoustic modems than the old-fashioned way. Without controllable doors then the fishermen must pay out more line to get them deeper. This is not only slower but is far less convenient than sending a modem command.


Trawler doors are used to control the spread of the fishing net (Courtesy of Marine CTRL / Polaris Fishing Gear)

ISURUS ROV OPENS OPERATING WINDOWS FOR RENEWABLES PROJECTS

Designed for the harsh weather conditions faced by offshore wind and renewables developments, the Isurus ROV stays in operation longer than traditional vehicle systems.

Nick Rouge, Subsea Robotics Product Manager, Oceaneering



The Isurus ROV, based on Oceaneering's Magnum Work Class ROV system, combines optimized hydraulic propulsion packages and a hydrodynamic design for challenging offshore environments. (Courtesy of Oceaneering)

A desire for cleaner energy production that reduces carbon emissions is leading the energy transition effort. More companies are opting to develop offshore wind and other renewable energy projects around the world to meet proposed environmental standards. One issue that the industry has encountered is that most of these projects are in shallow water and areas where there are severe tidal or gulfstream currents, such as Europe, Asia, and the Eastern coastline of the United States. This challenge is familiar to the offshore oil and gas industry: how do you safely keep operations running when difficult conditions arise offshore?

Existing work class remotely operated vehicles (ROVs) are struggling to keep up with these raging tidal currents found at these offshore wind and renewable project development areas. Without a work class ROV available to monitor or execute operations, the entire vessel is put on hold, creating unnecessary and costly downtime.

Oceaneering was approached by an offshore renewables developer to create an ROV solution that would open operational windows in these geographical areas where harsh currents can cause costly project delays. Expanding an ROV's operating window in harsh currents brings obvious benefits due to typical cable lay vessel or construction vessel day rates ranging in excess of US$250,000 per day. A more flexible ROV for offshore wind projects would be necessary.

An Isurus ROV working on site at an Asia Pacific wind farm project in 2021. (Courtesy of Oceaneering)

Oceaneering took on the challenge, creating the Isurus high-speed, work class ROV system. Since its launch in 2019, the vehicle has demonstrated its ability to improve economics for offshore renewables projects by expanding the operating currents and vehicle speeds beyond those in which traditional work class ROVs typically work.

Four Isurus ROV systems are currently in operation in regions such as Northwest Europe and East Asia, performing offshore wind and tidal project construction without encountering currents that have exceeded the systems' capabilities to maintain station and execute work class tasks. Prior to the implementation of Isurus, regular work class ROVs were often unable to execute these same construction tasks for a period of up to 25% of any given day due to severe tidal currents.

REIMAGINING ROV OPERATIONS

Oceaneering operates one of the world's largest fleets of ROVs. One of the company's main heavy work class systems is the Magnum Plus ROV, a field-proven system utilized in offshore projects around the world. Since 2000, there have been over 200 Magnum Plus ROV systems in service.

To create a high speed, work class ROV that could maintain operational capacity in difficult tidal current conditions, Oceaneering looked inward to see how it could improve upon the Magnum Plus system. Using a proven ROV as a basis for the design of a new concept allowed for faster execution, kept costs down, and reduced the need for additional training for ROV technicians. Because the designs are compatible, the Isurus ROV can be swapped with existing ROV systems already offshore and utilize existing spare parts, system components, and other infrastructure.

Oceaneering's design team took the Magnum Plus shape and adapted it to become more hydrodynamic while leveraging the vehicle's existing powertrain design. This greatly increased the new Isurus vehicle's operational capabilities, ensuring that it is a fully capable high-speed work class system.

Isurus boasts two 85 horsepower hydraulic power units, horizontal and vertical propulsion, and is rated for 10,000 ft (3,000 m) water depth, also like its Magnum predecessor. It is also equipped with two hydraulic manipulators, delivering the same hydraulic and electric power for tools and payloads as the Magnum Plus. When required for survey projects, the Isurus can be equipped with a full suite of survey sensors for route, cable, and pipeline surveys in areas of high currents or when high survey speed is necessary.

The Isurus ROV is designed specifically for the harsh currents faced by offshore wind installations. (Courtesy of Oceaneering)

One of two Isurus ROVs on location at an Asia Pacific wind farm project in 2021. (Courtesy of Oceaneering)

Traditional ROV systems are limited to speeds of 1.5 to 2 knots, while the Isurus ROV achieves speeds up to 5 knots — 2.5 times faster than any other work class vehicle. This step-change in performance transforms the ability to complete work scopes in high currents and harsh environments.

The Isurus ROV uses Oceaneering's ORCA (Online Real-Time Condition Assessment) software system for managing operations. This system enables ROV pilots, technicians, and supervisors to work with better, simpler controls, enabling them to focus on planning and execution of the complex task scopes of the offshore renewables industry.

While Oceaneering's vehicle engineering team spanned the globe, the Isurus ROV was manufactured at the company's facility in Morgan City, Louisiana. It was there that it underwent full and robust factory acceptance testing. The vehicle completed speed and agility testing, where its capabilities were confirmed in late 2019.

CASE HISTORY

After completing its robust testing regime, the Isurus ROV went straight to work for a major offshore wind developer across its Northwest Europe offshore wind farm in late 2019. The developer was interested in improving the performance of its vessel and enabling it to deliver more efficient cable lay activities. The Isurus ROV assisted with cable touchdown monitoring, cable installation, monopile pull-ins, and as-left/built surveys.

After more than two years in operation, the Isurus ROV has not encountered a current that could shut down operations. It has performed with better than 99.73% uptime for more than 3,500 dive hours.

This first Isurus vehicle has also been configured for high-speed survey with pipetrackers, multi-beam echo-sounders, and sub-bottom profilers. As a stable high-speed platform for survey sensors, Isurus provides improved performance and economics for route clearance, unexploded ordnance (UXO) survey, and pipeline and cable inspection.

In Q1 2021, three additional Isurus ROVs joined Oceaneering's fleet. A pair of the vehicle systems are operating at an Asia Pacific wind farm project throughout this year, keeping station in currents exceeding 2.6 knots. Traditional ROV systems on other support vessels in the same project have been unable to continue to operate in these challenging conditions. A fourth Isurus vehicle is now at work supporting construction of a tidal power project.

Oceaneering's Isurus ROV continues to provide differentiated project economics to the offshore renewables market globally. For projects requiring work class ROV operations, the Isurus ROV provides a direct replacement solution to today's work class systems unable to work in harsh current environments.

PLOUGHING AHEAD

50 YEARS OF SUBSEA EXCELLENCE FROM SMD

As Soil Machine Dynamics (SMD) enters its 50th year, we caught up with Chairman, Mike Jones, to take a look back on its pioneering history and catch a glimpse of what's in store for the future.

RICHIE ENZMANN: How did SMD start?

MIKE JONES: Back in 1971, Dr Alan Reece, who was then a lecturer in the Agricultural Engineering Department, at the University of Newcastle, started up SMD to facilitate his consultancy work. Our first product was to simulate the wear on turf by football studs – very appropriate to the North East! Around this time Alan was approached by BP who had to find a way to protect its pipelines in the newly developing North Sea from the threats of trawling as well as the occasional anchor.

Following extensive research, he eventually left the University with some colleagues and his best graduates to set up an operation to design and manufacture the first machines to bury pipelines and flowlines on oilfields like Magnus with early clients including Brown & Root and UDI Marconi.

RE: Tell us more about SMD's first few innovations...

MJ: The product which really enabled SMD to develop and prosper as an enterprise was the Cable Plough that was built primarily for the telecommunications market. What made this plough a world first was its ability to bury and protect cables as they were laid from the cable vessel efficiently and safely.

This was in 1983 with BT being our first customer but it was quickly adopted by the other main players at the time, Cable & Wireless and AT&T. The business premises at this time were still at Alan's home in Wylam, Newcastle, but given the plough's success, the team moved from Alan's home to Beaumont House, an old school house near Bywell further along the Tyne.

1971.
University of Newcastle Professor Alan Reece sets up SMD and develops plough technology
(Courtesy of SMD)

Alan also acquired the Pearson companies based in Low Walker to form the Bywell Group – a fabrication and a defence equipment company building mine ploughs to protect tanks and military vehicles.

RE: What happened next?

MJ: The advent of fibre optics in the 1990's meant that submarine telecoms took off, and so did SMD.

Following Alan's son John taking over as MD and Alan staying on as Chairman in 1994, we diversified into other products for burying and maintaining cables in different ground types: heavy tractors with cutters for hard ground and ROVs with water jetting for sands.

Another relocation happened around this time too, this time to be with the other Bywell Group companies at Low Walker based on the Tyne, near the old shipyards.


1992.
Beach trials of the first commercial seabed tractor launched into the telecoms market in 1992 (Courtesy of SMD)


1998.
MD3 Power Cable plough launched (Courtesy of SMD)

1995.
First commercial free swimming jetting ROV launched (Courtesy of SMD)

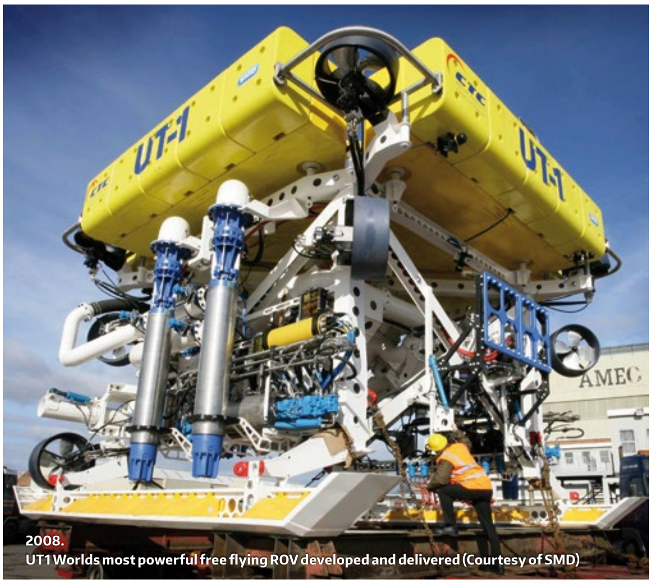
We also developed our own launch and recovery equipment bespoke to the needs of trenchers, and later using this knowledge to develop equipment for laying fibre optic cables. This included the Safe Fleet Drum Engine that instead of using knives or rings to control the helix of cable on the drum, had a clever moving surface which was kinder to the cable.

By the end of the millennium we could deliver all of the cable lay, subsea burial, and subsea maintenance equipment on a single cable ship. At this time SMD employed over 100 people.

RE: How did SMD, now a telecoms equipment company, cope with the Dot-com Crash?

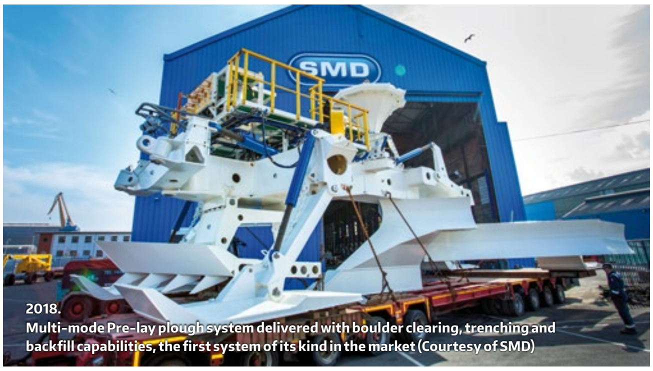

2003.
Cable lay & burial tractor delivered for offshore wind (Courtesy of SMD)

2005.
First Work Class ROVs sold to the Oil and Gas market (Courtesy of SMD)



2008.
UT1 Worlds most powerful free flying ROV developed and delivered (Courtesy of SMD)

2017.
SMD were technical lead in the VAMOS project – viable alternative mine operating system (Courtesy of SMD)



2018.
Multi-mode Pre-lay plough system delivered with boulder clearing, trenching and backfill capabilities, the first system of its kind in the market (Courtesy of SMD)

MJ: When the 'Dot-com' bubble burst, our main market disappeared overnight, and we had to retrench and rapidly reposition SMD.

We bought the brand, IP, and assets of Hydrovision – an Aberdeen based manufacturer of Curvetech® components and work class ROVs. In 2004, we had started to design and manufacture our own range of Work Class ROV systems – the Quantum, Quasar, and Quasar Compact. Winning clients like Subsea 7 and Hallin Marine, the business began to grow again.

It's in our DNA to innovate and back in 2003, at the same time we were beginning to manufacture our own work class ROVs, we also built our wind farm inter-array trencher for the round one wind farms. This was a novel machine called the Lay & Burial Trencher for Mayflower – it could lay and bury an inter-array cable while its host TIV was erecting the turbine.

Later that decade, we delivered two notable trenchers: UT1, the world's most powerful free-flying jet trencher; and RT1, the world's most powerful rock trencher.

In 2007, we won a contract to build the world's first deep water, commercial seafloor mining machines for Nautilus Minerals based in Brisbane.

Then John Reece decided to sell the company, and I and the other Directors, Peter Imlah, Richard Howarth and Paul Atkinson, did a management buy-out backed by private equity group, Inflexion.

At this stage SMD had grown again to around £40m revenues and was much more diversified across markets and products. Then in late 2008 Andrew Hodgson joined as CEO.

RE: Tell us more about the Nautilus Minerals project

MJ: The Nautilus project finally restarted in 2010, following the recession, and became a much larger project with three different machines for preparing the mine site (Auxiliary Machine), cutting the bulk of the ore on shelves (Bulk Cutter) and collecting the ore from stockpiles (Collection Machine). Along with the Launch and Recovery Systems and Umbilical it is the largest contract and heaviest contract we have ever performed. It was a hugely technically challenging project to create a system which could continuously mine at depth, on extreme slopes, in very hard rock and to minimise its impact on the environment. But we did it, they were delivered in 2016 and tested in shallow water in PNG.

RE: How did SMD end up being acquired by CRRC Times Electric?

MJ: During this period, we also won several 'super bid' contracts for ITech (part of Subsea 7) to provide ROVs for services to Petrobras in Brazil. This resulted in SMD supplying 42 work class ROV systems – Centurion Ultras and Centurion SP's. We continued to grow within the renewable sector, particularly within windfarms and had a very busy period supplying trenching machines for the Round 2 wind farm cable installation in the UK and Europe.

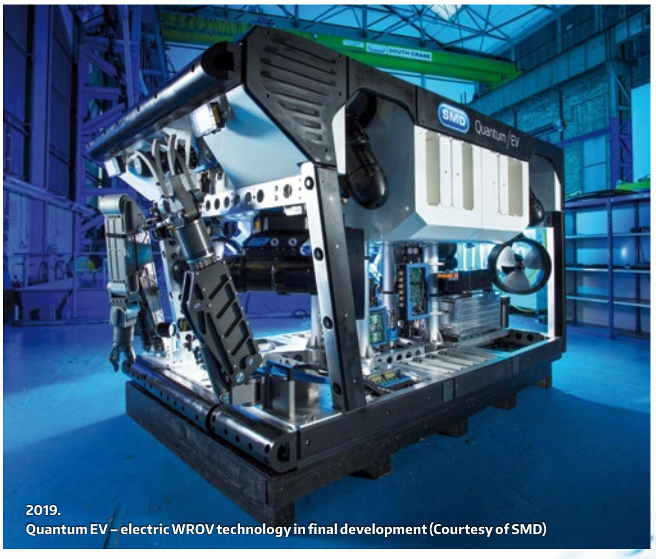
These included trenchers and ploughs for Fugro, General Cable/NSW, Technip Offshore Wind, Global Marine and Reef Subsea. A standout project was the QTrencher 1400 for Fugro – that set a new benchmark for a high power, modular system that could trench in the widest range of conditions and be launched in heavy sea states.

The growth in ROVs and Trenchers along with the Nautilus project really put us on the map. We tripled our revenues to over £100m, and staff to over 400, all based in our new home on the River Tyne in Wallsend.

Our success had gone global and in 2015, we were acquired by CRRC Times Electric from Zhuzhou in China. CRRC is a diversified company with core technologies in power conversion and control, and markets in rail, EV's, wind turbines, high power semi-conductors, and marine. It was a natural step for the evolution of SMD.

I spent more and more time in Shanghai at this point, establishing our new operation and was made CEO in 2017.

RE: What's next for SMD?

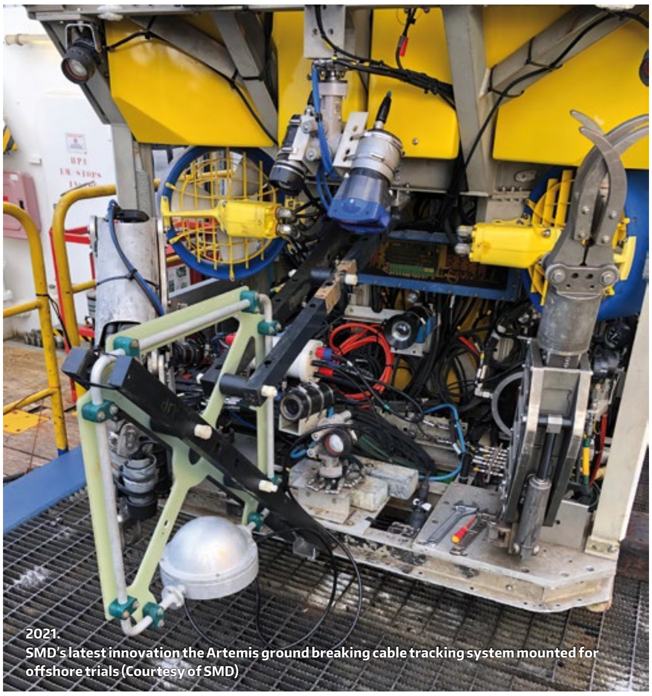


2019.
Quantum EV – electric WROV technology in final development (Courtesy of SMD)

2019.
Quasar reaches maximum operating depth of 6000m during sea trials – see top right image (Courtesy of SMD)

2019.
Quasar reaches maximum operating depth of 6000m during sea trials (Courtesy of SMD)

2020.
BT 2400 – aka Deep Diggit – the world's deepest trencher delivered to Van Oord (Courtesy of SMD)


2021.
SMD's latest innovation the Artemis ground breaking cable tracking system mounted for offshore trials (Courtesy of SMD)

MJ: Since the acquisition, there has been heavy investment in R&D and in particular a big focus on developing next generation core technologies for subsea Electric Vehicle's (EV's). Focusing initially on using this in Work Class ROVs and their LARS.

We have also received support from InnovateUK for this development. The first of these, the Quantum EV, is in the final stages of development and testing. The smaller, Atom EV, uses the same building blocks and a new electric TMS is in testing.

The vehicles will bring new levels of control, performance, and efficiency which together with reduced need for maintenance will enable use with ASVs and in residence. The EV will also be a greener, more cost-effective solution for more conventional applications.

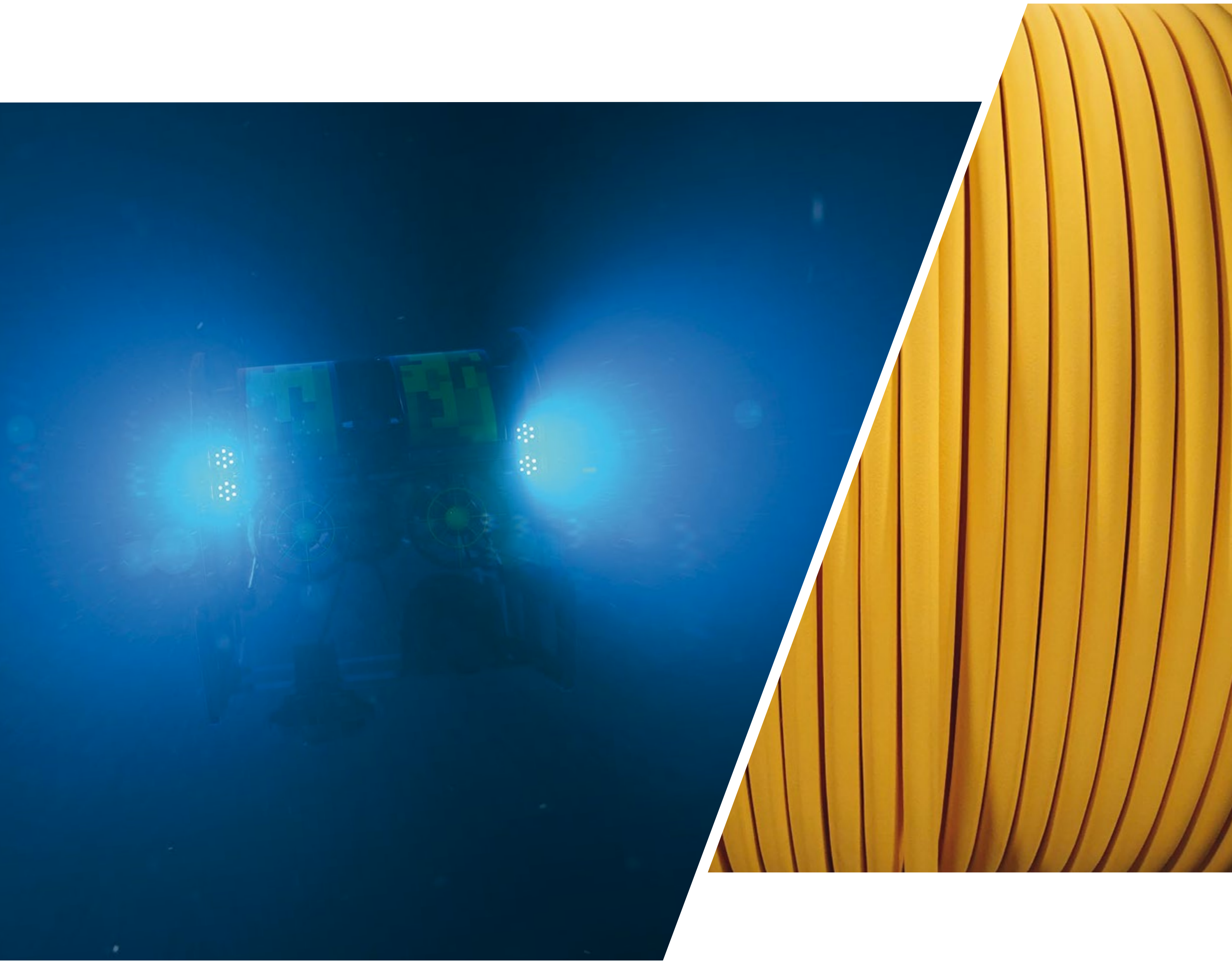
Wind Farms will also remain a core focus for us. We have supplied more powerful and capable trenchers and ploughs to Van Oord, Boskalis, AssoSubsea and Prysmian among others. We have also invested in the development of a more accurate cable detection system, Artemis, that can track untoned cables beyond 3m, in addition to its use on live cables.

As well as wind, we are continuing to develop our subsea minerals arm, being the lead partner in the VAMOS project, funded by the EU Horizon 2020, to develop technologies for on-land submerged mining.

The situational awareness and visualisation system can also be applied to deep water mineral collection. They have also been developing ways of harvesting seafloor nodules to minimise disturbance to the environment and maximise efficiency.

The past 50 years has seen SMD navigate a path through many markets and technologies as a pioneer in the subsea arena. This has been achieved through a culture of pursuing engineering excellence and looking at problems differently to solve them for our customers. It has also been done through great teamwork and making SMD an enjoyable place to work. None of this would have been possible without so many talented leaders, engineers, technicians, and other members of the team that have committed themselves to doing this.

SMD



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Courtesy of European Defence Agency

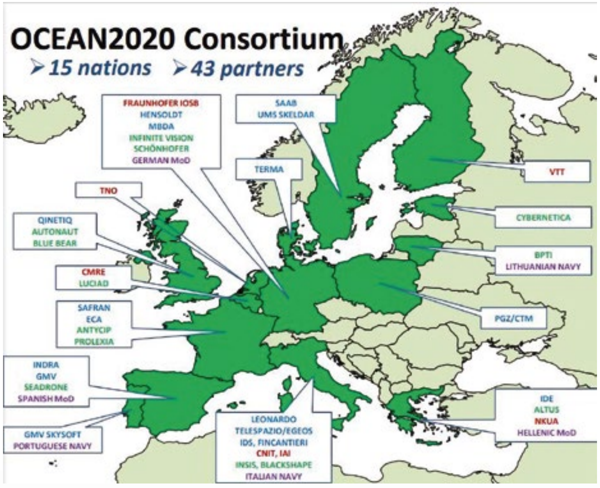
OCEAN 2020

OPEN COOPERATION FOR EUROPEAN MARITIME AWARENESS (2018–2021)

TECHNOLOGICAL DEMONSTRATION FOR ENHANCED SITUATIONAL AWARENESS IN THE NAVAL ENVIRONMENT

By Richie Enzmann, ROV Planet and Antonino Arecchi, Leonardo S.p.A.

Funded by the European Union's Preparatory Action on Defence Research (PADR) and implemented by the European Defence Agency, the OCEAN2020 "Open Cooperation for European mAritime awareNess" project represents the ambition and vision of a European maritime initiative, in line with the strategic approach shared by all its participants.



Courtesy of European Defence Agency

Coordinated by Leonardo, OCEAN2020 brings together 43 partners from 15 European countries for a project duration of 36 months, and is focused on the development of a "Technological demonstrator for enhanced situational awareness in a naval environment" with the following aims:

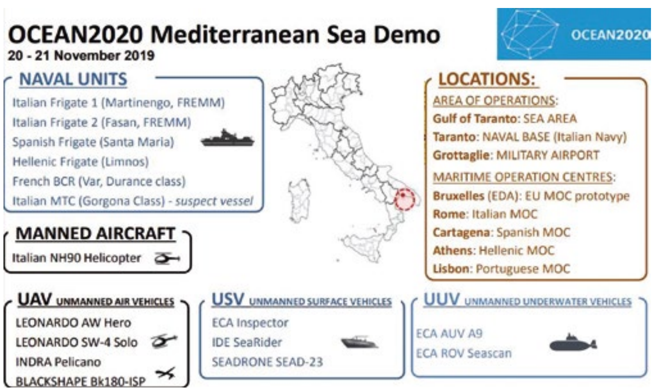
- Enhanced situational awareness in a maritime environment through the deployment and integration of Unmanned Systems;
- How to meet the challenges in Persistent Wide Area Surveillance and Maritime Interdiction;
- How to accomplish a project of substantial complexity in a demanding timescale through EU wide cooperation of end users, large industries, research institutes, and small/medium enterprises.

Nowadays, in an ever-changing international security environment, naval forces are permanently engaged in various types of conflicts, including asymmetric and conventional threats. They must control their environment to scan, detect, and analyse the potential threats as soon as possible, and to retain capacity for initiative, freedom of movement, and achieve the desired end-effect. In this respect, maritime Intelligence, Surveillance, Target Acquisition, and Reconnaissance (ISTAR) chain is a critical enabler to the common Recognized Maritime Picture (RMP), for detection, identification, tracking, and target acquisition, as well as for strengthening interoperability.

Within this context, OCEAN2020 will pave the way for future EU defence cooperation or initiatives by integrating legacy and new technologies for unmanned systems and ISTAR payloads. Data from multiple sources will be exploited into an RMP. The aim is to have a common RMP shared between national Combat Management Systems (CMSs) and form the front line of a future EU Maritime Operation Centre (EU MOC).

SEA DEMONSTRATIONS

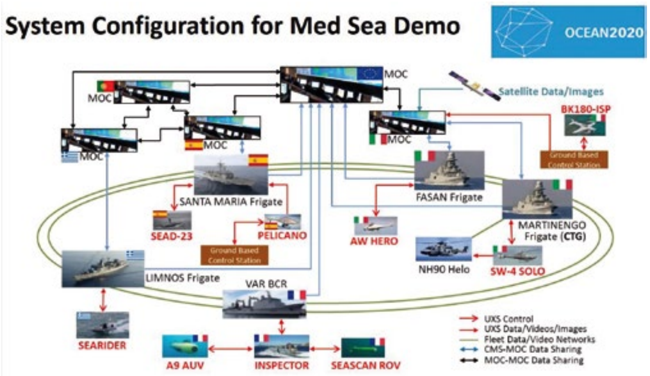
Two live demonstration trials were planned in the Mediterranean (2019) and Baltic Seas (2021). Both will contribute to achieving a common single picture in the EU-MOC and will be conducted in conjunction with national operational exercises deploying existing military platforms.



Courtesy of European Defence Agency

THE FIRST SEA DEMONSTRATION IN THE MEDITERRANEAN SEA, GULF OF TARANTO

The first sea demonstration was successfully launched on the 20th and 21st November 2019 in the Gulf of Taranto, Italy. The OCEAN2020 Live Sea Demonstration involved a total of nine unmanned assets and five naval units. Moreover, the demo established five naval command stations: EU, Italian, Spanish, Portuguese, and Greek. All units were supported by five satellite systems: COSMO SkyMed, ATHENA FIDUS, HELLAS, SYRACUSE, and INMARSAT to provide the necessary communication network and surveillance activities.



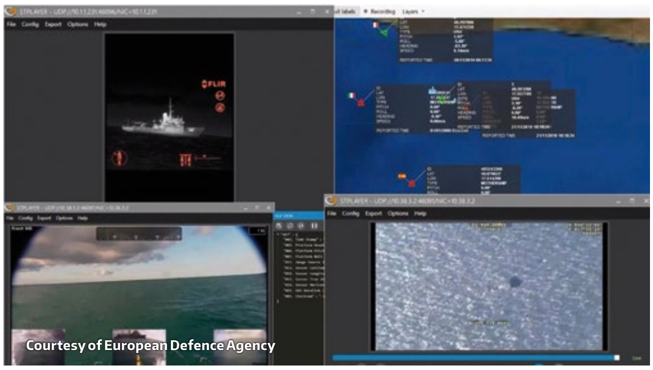
Courtesy of European Defence Agency

The sea exercise focused on two scenarios which enabled demonstration of the following:

- the launch and recovery of UxS from Vessel including automatic take-off and recovery of Remotely Piloted Aircraft Systems (RPAS)
- the integration between tactical unmanned assets and naval CMS (Combat Management System)
- manned-unmanned teaming and cross-cueing of unmanned systems
- the use of strategic (i.e., satellite) and tactical assets (i.e., airborne ISTAR manned / unmanned) to multi-spectrum multi-source data collection and distribution for augmenting situational awareness
- and finally, the link chain of information flowing from the assets to the naval Combat Management Systems and then to EU MOC prototype (or demonstrator) and national MOC.

SCENARIO 1: WEAPONISED FAST BOAT INTERDICTION

Videos and tracks generated by all unmanned systems, thanks to the advanced communication infrastructure, were visualised in real time at the MOCs. What's more, they were also presented onboard the different ships of the Task Group, not just the ship controlling each system. During the operation, the frigates were tasked to provide visual tracking, with their USVs and UAVs deployed in different areas.



Courtesy of European Defence Agency

Scenario 1 was executed in the following phases:

- PHASE 0 – Scenario preparation / Persistent surveillance.
- PHASE 1 – Alert for anomaly detection.
- PHASE 2 – Resource tasking and area search.
- PHASE 3 – Localisation, classification, and identification.
- PHASE 4 – Surface engagement (simulated).
- PHASE 5 – UW localisation of the threat remains.

Starting situation

At the beginning the Task Group is deployed in a friendly gulf to protect naval shipping and fishing in a situation of increasing tension with a neighbouring country. Persistent surveillance using satellite sensing and fixed wing aircraft (including BK180-ISP OPV) is performed in the area.

Phase 1 – Alert for anomaly detection

An alert is automatically generated based on the COSMO-SkyMed satellite acquisitions, highlighting an anomaly (suspect ship, based on pre-defined criteria) coming from the gulf entrance. The CTG (Commander Task Group) investigates the contact of interest.

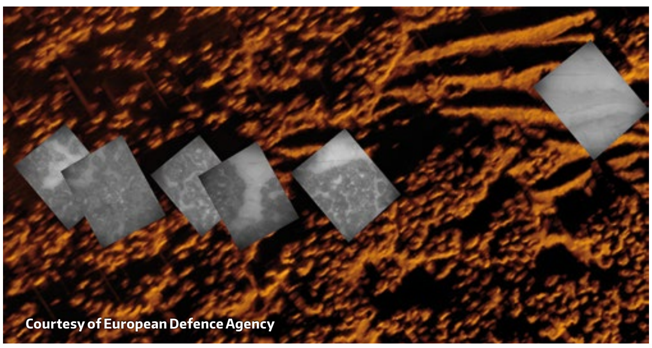
Phase 2 – Resource tasking and area search

CTG requests all Task Units to raise their readiness level, deploying their unmanned air and surface vehicles, while the BK180-ISP OPV – already in flight for surveillance in the gulf – is tasked to investigate the contact of interest. BK180-ISP OPV finds an unknown vessel with compatible position and displays it in the EO video. After finding the suspect vessel, it's piloted back to the airfield due to a simulated fuel shortage and the contact is lost.

Courtesy of European Defence Agency

Phase 3 – Localisation, classification, identification

The Fasan frigate locates the vessel with the UAV AW HERO, classifies and identifies it as suspect. The other frigates are tasked to provide visual tracking with their USVs and UAVs deployed in different areas. The USV SEAD-23, then the USV SEARIDER and UAV SW-4 SOLO, find and follow the suspect vessel with EO cameras and surveillance radars while it moves northward. After hailing from Martinengo frigate and receiving wrong data then no answer from the suspect vessel, the contact is classified as hostile.



Courtesy of European Defence Agency

Phase 4 – Surface engagement

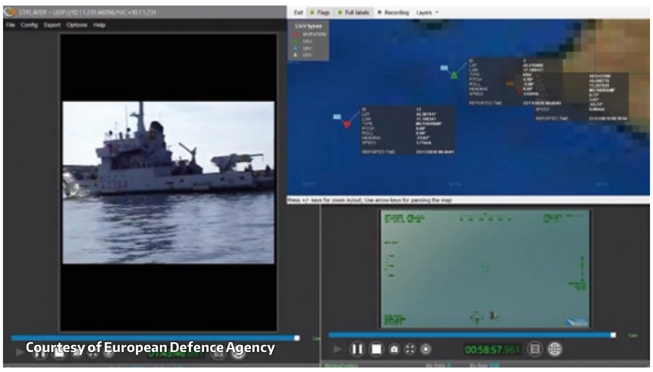
When the vessel changes course directly to menace the Var BCR, actions are taken (following rules of engagement) to first deter then destroy the threat. A first engagement for dissuasion is conducted from the Var BCR using the INSPECTOR USV (interception, horn warning, voice warning). As the threat continues moving towards the ship, the threat is engaged with guns from the Martinengo frigate (engagement simulated), supported by close video of the target from SW-4 SOLO UAV. Damage assessment is also supported by SW-4 SOLO UAV and INSPECTOR USV videos (the target is considered sunk).

Phase 5 – UW localisation of the threat remains

The Var BCR is tasked to search and locate the threat remains on the seabed with its UUS (a real wreck was reported in nautical charts to be in the area). The AUV A9 and ROV SEASCAN carry out the underwater search, the latter deployed by the INSPECTOR USV (only rock formations are found).

SCENARIO 2: INTERCEPTION OF A MINE LAYING THREAT DURING AN AMPHIBIOUS OPERATION

This scenario involved covert and overt tracking of a suspect vessel using unmanned vehicles: UAV to support a boarding action, and UUV to search and localise mines on the seabed.



Courtesy of European Defence Agency

The ongoing situation was presented on the maps, based on information from different sensors and optical satellite images. It was combined with simulated intelligence data and indicated the presence of a suspect Fishing Vessel (FV) in a nearby port (controlled by an unfriendly faction) believed to be a disguised mine-laying vessel.

Scenario 2 was executed in the following phases:

- PHASE 0 – Scenario preparation / Intelligence received.
- PHASE 1 – Suspect vessel leaves the harbour and is detected by USV and UAV.
- PHASE 2 – Covert localisation and tracking with UAV.
- PHASE 3 – Mines are released by the vessel.
- PHASE 4 – Boarding with UAV support.
- PHASE 5 – Mines localisation and identification with UUV

Starting situation

A "Union" of countries considers intervening by amphibious landing in a country experiencing a crisis situation with different


Courtesy of European Defence Agency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factions in conflict. At the beginning, the Task Group is deployed near the selected AOA (Amphibious Operation Area), within shaping operations for a possible amphibious landing. Change detection maps and optical satellite images – combined with simulated intelligence data – indicate the presence of a suspect Fishing Vessel (FV) in a nearby port (controlled by an unfriendly faction) believed to be a disguised mine-laying vessel.

Phase 1 – Suspect vessel leaves the harbour and is detected by USS and UAS

While performing a surveillance flight in the gulf, the BK180-ISP OPV (is tasked to provide video of the port area where the suspect FV was moored on the latest satellite images, while the Limnos and Santa Maria frigates are tasked to perform surveillance around the harbour with their USV and UAV in pre-defined areas. The video from BK180-ISP flying over the port shows that the suspect FV is no longer present at the reported mooring position. SEARIDER USV and PELICANO UAV detect the vessel while leaving the port bay. USV SEAD-23 then follows the FV as it moves along the coast towards the AOA.

Phase 2 – Covert localisation and tracking with UAV

The Fasan frigate is tasked with providing covert localisation and tracking of the FV using AW HERO UAV, while SW-4 SOLO UAV is used by the Martinengo frigate to perform a visual survey (with EO camera) of the selected landing area. SEAD-23 stops following the FV when it is detected by the AW HERO. When the FV is approaching the sea area facing the selected landing area, SW-4 SOLO is re-tasked to follow the FV through close visual tracking.

Phase 3 – Mines released by the suspect vessel

Mines drop from the FV (simulated by dropping empty barrels tied with a rope, recovered shortly after) are displayed on SW-4 SOLO EO video. When the FV realises it's being observed, it stops dropping mines and starts moving towards the open sea.

Phase 4 – Boarding operation with UAV support

The Martinengo frigate then executes a RHIB boarding action to take control of the vessel, with support of the organic NH90 helicopter (in sniper role) and the UAV SW-4 SOLO. The close-up video of the target vessel from SW-4 SOLO point of view is shared in live streaming with the NH90 crew and the boarding team on the RHIB.

Phase 5 – Mines localisation and identification with UUV

The Var BCR (playing the role of a mine-hunting vessel) is tasked with detecting the mines dropped in the area using the A9 AUV and SEASCAN ROV, the latter being deployed by the INSPECTOR USV (filled barrels were dropped in the area before the trial, to simulate mines on the seabed). The "mines" are located on the seabed and shown in live video streaming from the SEASCAN ROV.

The second demonstration will take place during the summer of 2021 in the South-Eastern part of Sweden. The location enables a mix of unmanned and manned assets as well as all facilities for hosting a wide range of platforms including airborne. The two scenarios will be based on the utilization of different unmanned systems that will prove their capacity of patrolling, detection, identification and classification of threats, thanks to the information acquired by different types of sensors. In particular, some unmanned systems will be deployed for patrolling and threat detection, while others will track threats up to interception and dissuasion.

EXPECTED IMPACTS

Due to the broad focus of the project from the unmanned perspective, the expected impacts include the development of European industrial capability in unmanned systems for defence capabilities. It will enable substantial gains towards autonomous and safe operation of UxS from navy ships, offering suitable potential in terms of payload capacity, range, and handling quality for operations under adverse conditions. Furthermore, the improved interoperability between manned and unmanned systems will shape future military structures in view of the use of advanced unmanned systems.

Technologies demonstrated in OCEAN2020 will improve maritime awareness and response. In particular, Persistent Wide Area Surveillance is functional to missions carried out both in warfare scenarios and in operations against threats (terrorism, drug trafficking, acts of piracy, illegal transport of migrants, etc.), defending sovereignty and sovereign rights at sea.


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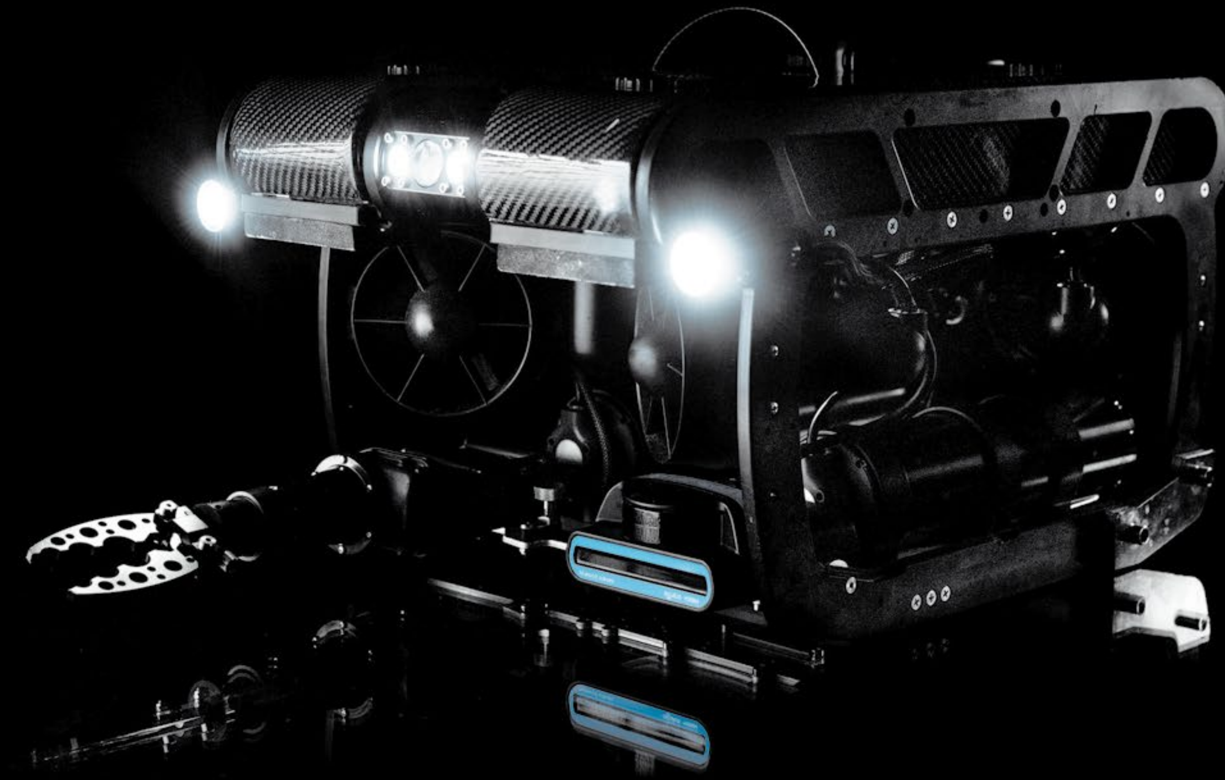


ROV Pivot Nav (Courtesy of Deep Trekker)

DEEP TREKKER
TREKS INTO TECH

By Capt. Marc Deglinnocenti, gofundme.com/captain-marcs-maritime-fund

Deep Trekker of Ontario, Canada has been making ROVs since 2010, and they've never rested on their past laurels as President Sam Macdonald will gladly tell you. She will also tell you that Deep Trekker is always developing new ROVs. So far, they have sold their products to 99 different counties, but they're always looking for number 100! Her company's latest ROV is called the Pivot Nav. This carbon fiber, stainless steel, and aluminum ROV has six independently controlled thrusters that are magnetically coupled for leak proof deep diving. What's so special about another 305 metre (1000 feet) deep diving ROV? The answer lies in the new concept of controlling it.

Instead of tilting the whole ROV to perform various tasks, the new equipment platform tilts while the ROV frame remains level. This allows for better control of the ROV Pivot Nav in complex current situations. Their new stability and station keeping software along with the tilting equipment platform brings this fine control system together. Their new

ROV Pivot Nav with manipulator arm with multiple attachment options available. (Courtesy of Deep Trekker)

ROV Pivot Nav (Courtesy of Deep Trekker)

ROV Pivot Nav with integrated tilting camera, lights, and laser scale. (Courtesy of Deep Trekker)

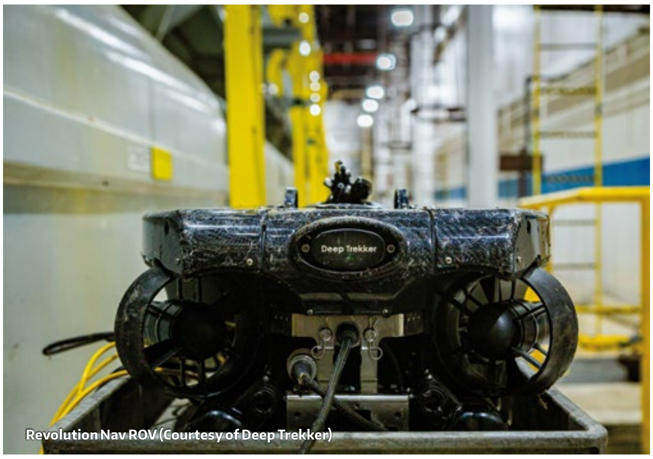
stability software even allows for the secondary benefit of it becoming a semi-autonomous ROV. This means that you can preprogram most of the dive for better efficiency. This is especially true for waters with low visibility. After the ROV guides itself to its intended target, you can then hover the ROV in one position while it automatically adjusts itself for the currents. Most other ROV pilots will find it very difficult and time consuming to hover their ROVs in comparable high currents. Then when they try to tilt their ROVs to use a tool, they wind up fighting the currents all over again. This can be frustrating to say the least and even dangerous to their ROVs at the worst. Now, instead of tilting down the whole ROV to use a tool like the grabber arm, you just tilt the platform that the arm is mounted to without disrupting your ROV station keeping. It even has a turn count readout so that you don't get your tether all twisted up. That helps with controlling it too! This simple concept of flipping around the tool movements is a huge leap forward in ROV control technology.

The tilting or "ROV pivoting" tool platform technology is not the only thing that pivots either. The high-definition camera also tilts along with its intergraded lights and laser scale. Additional frame mounted lights help too. You can even mount a multibeam sonar to the tool platform for up to 97 vertical degrees of vectored scanning. There are many other options available for this new 17 kg (37.5 pounds) portable ROV. This innovative single ROV has a base price of $45999 USD (£33269, €38897). More Pivot Nav technologies are on their way too.

This three-hour endurance ROV comes with two sets of batteries for a six-hour dive day without having to recharge. It takes 1.5 hours to recharge a battery though, so you can easily keep going beyond a six-hour workday. Deep Trekker will soon have an optional power supply for this ROV for continuous dive operations without having to resurface to swap out the battery. The most popular option, however, is the grabber arm, but even that has options of its own. There is a dizzying array of arm attachments available such as two or three jaw claws, an interlocking claw that wraps completely around an object, a caliper for precise measurements, a benthic sediment sampler for the researcher in us all, a water sampler that you can use at various depths, an even a cable cutter. Some other options include a carrying case, net patch kit, mort claw, grappling hook, thickness gauge, multibeam sonar, Ultra Short Baseline (USBL) positioning, Doppler Velocity Log (DVL), depth and altitude sensors, heading, pitch, roll, and temperature sensors, Cathodic Protection (CP) probe, dissolved oxygen gauge, hydrophone, and a Sonde Water Analysis sensor.

The Sonde Water Analysis sensor is a suite of sensors within itself. A typical Sonde sensor can measure water temperature, conductivity like a CP probe, depth, pH- which is critical for aquafarming, Oxygen Reduction Potential (ORP), Dissolved Oxygen (LDO) also for aquafarming and research, dissolved oxygen (Clark Cell), turbidity, chlorophyll A, blue-green algae, Rhodamine WT- which is a fluorescent dye for current

Revolution Nav ROV (Courtesy of Deep Trekker)



Revolution Nav ROV (Courtesy of Deep Trekker)

tracking, ammonium, nitrate, chloride, Total Dissolved Gas (TDG), and the ambient light. That's a lot of scientific data from one ROV! All of these hardware add-ons aren't the only options either. There's a great software upgrade available too.

Deep Trekker has a great mission planning software upgrade available for the Pivot Nav. This new software will enhance your navigation and operation skills immensely. You can preplan all of your waypoints and then add or delete them as you go along during the dive. You can also customize your path along those waypoints to either avoid obstacles or make your objectives more achievable. Having the entire dive route mapped out in advance gives the ROV pilot a better idea of the ROV tether usage needed as well as an understanding of the overall dive area. Since the ROV position is constantly plotted on the map in real time, you can retrieve the ROV quickly should the need arise. This advantage is often overlooked and is seldom appreciated until it's needed, that is. You might need some help learning how to use all of the hardware and software options as well as operating the ROV itself. Don't worry; Deep Trekker has got your back.

They offer a free virtual ROV training course consisting of a series of online videos that you can review at your leisure. It's a basic ROV training program that's great for beginners, but there are technical trainers and customer service staff also available to provide all of the technical data of the ROV and its options as well as some great diving tips for their ROV users. No matter what your level of ROV knowledge or piloting expertise is, Deep Trekker is there to help.

So, don't fight your next ROV by trying to control it. Let the ROV Pivot Nav do all the autonomous diving work and current fighting for you while you do all the research work from a stable platform. The Deep Trekker ROV Pivot Nav is worth pivoting your head and tilting your eyes to take a look at.

Capt. Marc Deglinnocenti is a maritime technical writer. His sea time dates to 1974 in a wide variety of roles on sailboats, conventional and tractor tugboats, training ships, barges, warships, cargo ships, passenger vessels and research vessels. He can be reached by emailing oldarmada@gmail.com.

Deep Trekker mission planning software map. (Courtesy of Deep Trekker)

Capt. Marc Deglinnocenti (Courtesy of Capt. Marc Deglinnocenti)

GLOBAL ROV CONTRACTOR PLANS FOR
FUTURE EXPANSION

Film-Ocean Ltd, a Stapem Group company, is a Global ROV contractor providing subsea inspection and technical support to oil, gas, and renewable energy industries. To accommodate the company's recent growth and planned future expansion, the board of directors have approved investment into a new facility based in Ellon. The new combined office, workshop, and yard represent a significant increase in capacity compared to their current facility.

In addition to increased office space, the development includes equipment testing and inspection facilities, and training facilities with several large meeting rooms and breakout areas. The workshop will offer several dedicated areas to service a wide range of components. A key feature is the internal 5m³ test tank with overhead gantry crane to allow the wet test of all the company's ROV spreads, and includes a client observation platform. The development is scheduled to break ground in Q4 2021, and be complete in Q3 2022.

The new development will also include a dedicated Remote Onshore Control Room to support remote inspection and ROV operations. With advances in communication technology, a fast, reliable link between the onshore control room and the offshore ROV crews is now possible and affordable. This will allow specialist engineers to give input into the offshore works program, remotely supporting the operations from onshore. In addition, the onshore and offshore teams can stream video, live chat, and instant message in order to discuss real-time operations, delivering improved efficiency to the client.

Film-Ocean recently delivered "remote support" during an inspection work scope. The service allowed access to onshore based CP and NDT specialists for the project's duration, along with a successful proof of concept trial. The Onshore Remote Support function will enhance their clients' experience and the ability to provide even further support in real-time for its global operations. It will also add value, improve clients' efficiency within their subsea operations, and maximise operational windows. The new facility will ensure that Film-Ocean continues to expand its offering, and meet market requirements by providing its clients the additional expertise and access to specialised technical support in real-time. The system will be operational from Q2 2022, delivering support 24/7, 365 days of the year.

Film-Ocean's ROV fleet has expanded during the past 18 months, with investments in new ROV systems, including a Schilling Heavy Duty Work Class ROV and an additional Quasar 150HP Work Class ROV. The latest ROV to the fleet, the Schilling HD ROV, can operate in up to 4000m water depths, and is supported by an Active Heave Compensation Launch and Recovery System (AHC LARS). Since its delivery, it has been highly in demand, and has already been deployed on several offshore wind and oil and gas operations. As clients move to ultra-deep locations, the Schilling HD will be an ideal ROV solution to support construction, inspection, and decommissioning work scopes.

Scott Jenney, Film-Ocean CEO, said, "So far, 2021 has been extremely busy for Film-Ocean, and it is pleasing to see that we remain a trusted service provider for our expanding customer base. Our growth has enabled us to introduce job roles within the business, and it's good to be able to welcome new co-workers to the team, adding to the positive workplace culture we already enjoy.

"The recent investments have allowed us to continue to support the needs of our customers, and the addition of the larger Work Class ROV assets has allowed us to expand our capabilities significantly, and deliver on work scopes that we would previously not have been able to support.

"As we near capacity in our current facility in Ellon, we look forward to the development and completion of our new home in 2022. The purpose-built facility will allow Film-Ocean to provide the best available facilities to our staff, and ensure that our assets are maintained and tested to the highest possible standards. The additional capacity also allows us to develop and implement our Remote Operations Support Service that will deliver enhanced efficiency and benefits to our clients."

Major ROV contractor plans for 2022 Expansion (Courtesy of Film-Ocean)

PLANET

Please check out our website on:
www.ROVPlanet.com

The Isurus ROV is designed specifically for the harsh currents faced by offshore wind installations. (Courtesy of Oceaneering)

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Courtesy of RTSYS

RTSYS THE RISING COMPANY

Founded in 2010, RTsys is a French Company based in Caudan that specialises in passive and active underwater acoustics and AUVs. The company is part of the “Neotek” group, which has more than 30 years of experience in providing equipment for both the marine and naval industries. Focusing on technology, RTsys employs 40 people, including 20 high level engineers and PhD holders. Located on the Atlantic Ocean side of Brittany, RTsys possesses its own sea-test base and boats, enabling total independence for in-situ trials and customers’ acceptance tests.

As mentioned, RTsys' focus is passive and active underwater acoustics and AUVs. The full range of equipment is used not only in the defense sector (MCM and ASW), but also in the marine scientific community (IFREMER, KIOST, SHOM, DSO, etc.), as well as the industrial sectors of offshore windfarms, O&G, aquaculture, and more.

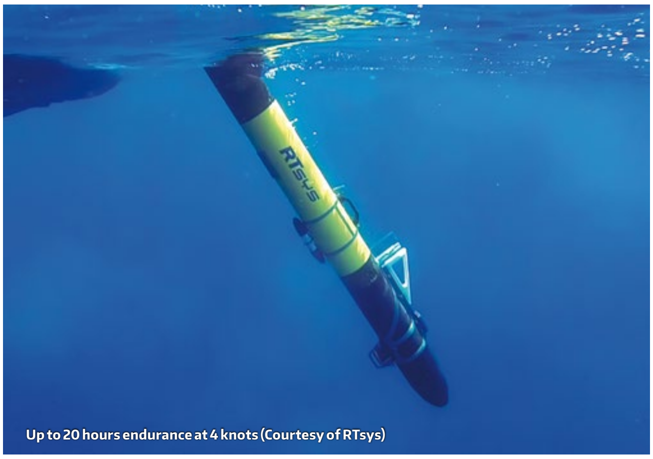
Every piece of RTsys equipment is fitted with an electronic board reference SDA® (Synchronous Data Acquisition) a technology developed by RTsys’ R&D team; it allows total control of hardware and software features. Thanks to this asset, RTsys remain proprietary of its own IP, and therefore doesn't rely on any third-party IP supplier.

COMET-300 easy recovery from a Rhib (Courtesy of RTsys)

Driven by innovation, RTsys invests significant amount of its own funds every year in R&D. While the acoustic monitoring devices which provided the foundation of the company remain, R&D investments have led to the design and supply of internationally renowned AUVs and diver-held sonar systems over the last decade. Those high-quality products have opened the door to new opportunities and markets for RTsys. RTsys is continuously growing and now relies on four lines of activity:

AUTONOMOUS UNDERWATER VEHICLES (AUV) SPOTLIGHT

RTsys range of AUVs is made of compact, two-men-portable and very compact man-portable micro AUVs (uAUV). Very powerful and endurant, the modularity of these vehicles enables a wide range of payload integration such as Side Scan Sonar (SSS) (both 2D and 3D image data), CTD, and any other type of water quality sensors. Integrated INS and DVL combined with surface



Up to 20 hours endurance at 4 knots (Courtesy of RTsys)

NemoSens µAUV reaching 300m depth (Courtesy of RTsys)


RUBHY acoustic and multi parameters buoy deployment at sea for environmental impact assessment during piling operations (Courtesy of RTsys)

communication modules enhance the navigation capability to an accuracy of less than 5m independent from the distance covered.

These strong features confirm the current success of the COMET-300 and NemoSens AUVs by the scientific, industrial, and military users. They operate with the most accuracy and reliability on the widest range of applications, including seabed mapping, cable and pipeline tracking, coastal water quality monitoring, windfarm inspection, survey and UXO detection, and finishing MCM operations.

COMET-300 AUV OR NEMOSENS µAUV

µAUVs are the easiest underwater vehicle to transport, deploy, and recover. Moreover, they're the most cost effective AUVs, which makes them very affordable for a variety of applications for universities and research institutes: marine biology, water, CTD, and O_2 monitoring, seabed mapping, acoustic survey, and more.

Micro AUVs can be launched and recovered by one person, from shore or a small craft (zodiac, rhib, etc.) without the need of a LARS (Launch And Recovery System). On the other hand, bigger AUVs can embed more batteries and payloads, allowing added capabilities in term of mission endurance and sensors to carry and use. Reasonable size payloads can fit either NemoSens or COMET-300. However, the largest devices won't be able to be integrated into the µAUV.

NemoSens development relies on RTsys experience in AUVs (the first COMET-300 was released in 2015). That experience has allowed RTsys a perfect understanding of the market, and to see what was missing. The AUV market nowadays has matured, but price still puts the brakes on for a lot of potential customers. Therefore, the development has been strictly cost-driven.

OPEN ARCHITECTURE

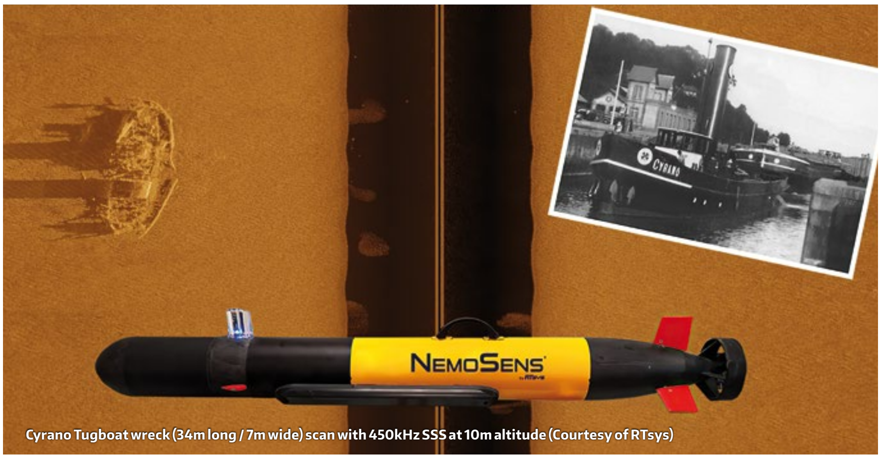
This allows users to easily integrate new payloads, without having to send the AUV back to the RTsys factory; they can consider new applications for their drone, and totally master it over the long term.

Users will also be able to customise the navigation (RTsys obviously keep some safety parameters that cannot be changed in order to preserve the AUV integrity). The open architecture also allows the customer to develop its own navigation pattern and test it in operation without any help.

Finally, COMET-300 and NemoSens both include a unique capacity for underwater communication based on RTsys' own protocol. That protocol – which is compatible with the whole RTsys range – includes both underwater communication and sparse LBL. This technology allows a real-time follow-up of the AUV positioning, with transmission of status info as well as data samples.

It also offers the possibility to enjoy repositioning features, leading to a constant positioning accuracy of 5m over the whole deployment, even for an AUV not equipped with a

SYLENCE-LP acoustic recorder before 180 days launching operation (Courtesy of RTsys)



Cyrano Tugboat wreck (34m long / 7m wide) scan with 450kHz SSS at 10m altitude (Courtesy of RTsys)


SonaDive equipped with gradiometer antenna on MCM mission (Courtesy of RTsys)

DVL. Customers and users are strongly convinced this is a significant game changer to increase confidence in the system while it is underwater.

PASSIVE ACOUSTIC MONITORING (PAM)

RTsys is a world leader in the design and manufacturing of acoustic recorders, buoys, and software for both post-processing analysis (up to 180 days autonomy), and real-time assessment.

The acoustic monitoring and recording combined with multiparameter sensor logs offer the best answer to a wide community of users, from marine renewable energy during installation (vessel traffic noise monitoring) and pile driving (noise and environmental impact assessment) to scientific users in marine biology, ambient noise, and water quality monitoring.

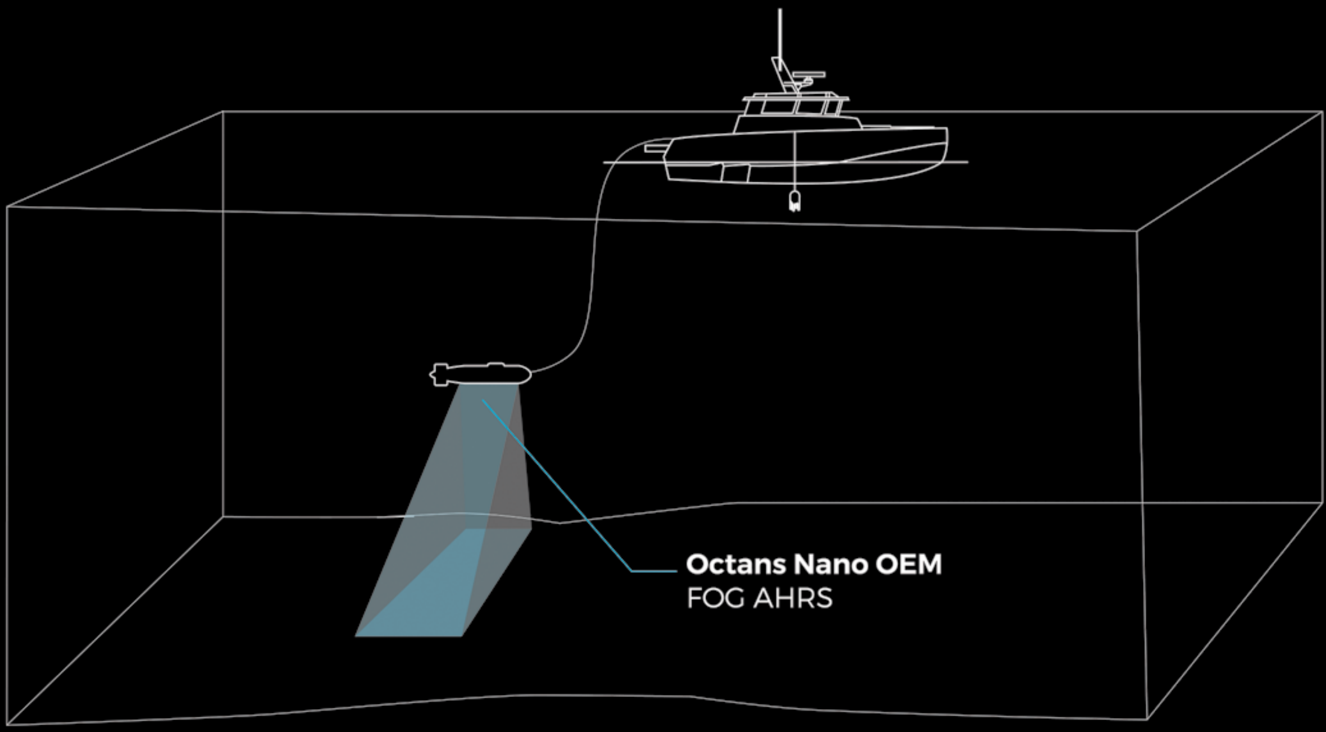
MINE COUNTERMEASURES (MCM)

RTsys provides EOD divers and special forces with a complete range of AUVs and diver-held navigation and sonar systems to upgrade divers' efficiency and safety during MCM operations. SonaDive is specially designed to assist military and professional divers in navigation and underwater object detection. The embedded navigation system relies on several sensors: INS, DVL, pressure sensor, and a deployable floating GPS. The contribution of native acoustic communication offers the most improved navigation thanks to the Sparse-LBL technology and allows constant accuracy during the mission (less than 5m as with the AUV range). Divers can communicate together and with the surface unit in real-time via the acoustic modem, sharing contacts and text messages over a range of more than 2km, reaching up to 5km using RTsys relay beacons.

Sonar and navigation data are fully recorded allowing mission replay, data analysis, and export. With 6 hours of battery life, the endurance can be extended by swapping batteries under water during a mission.

ANTI-SUBMARINE WARFARE (ASW)

Finally, RTsys is a world leader in the design and manufacture of acoustic system tests and ASW training, torpedo firing exercises, and acoustic signature measurements. The SIERA system offers the most reliable solution for the characterisation and calibration of underwater acoustic systems (hull- mounted sonars, dipping sonars, variable depth sonars, buoys), while SEMA acts as an autonomous and recoverable acoustic target dedicated to ASW training. It's operable for all kinds of platforms such as surface ships, submarines, helicopters, and ASW aircraft. Easy to deploy from both a RHIB or a frigate, the navigation route is plotted with either waypoints or segments. Different types of training modes such as passive, active, and combined acoustics can be programmed. SEMA is easy to operate and recover and is reconfigurable in one hour with a spare battery.



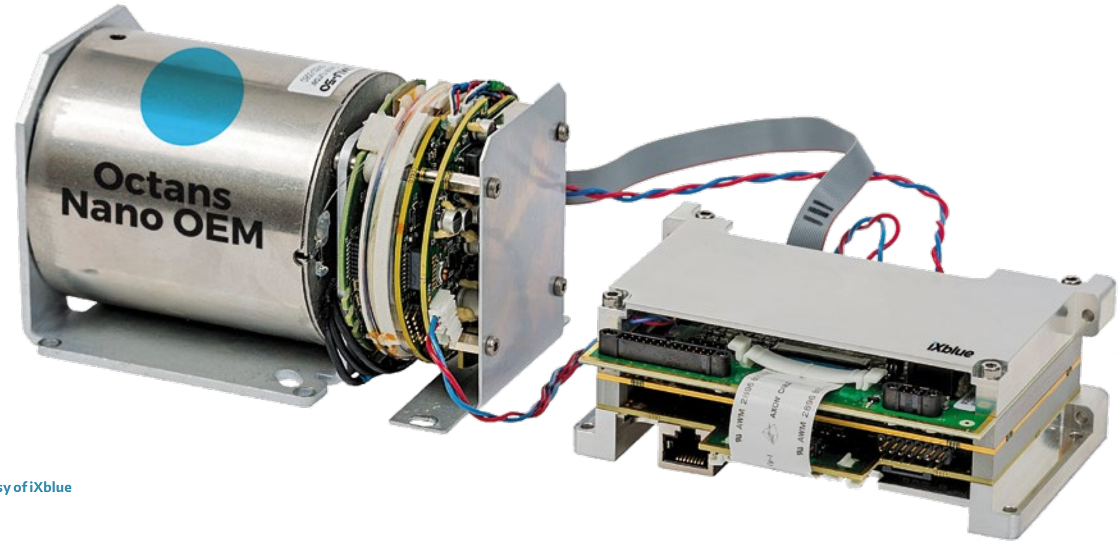
Courtesy of iXblue

IMPROVING TOW-BODY SONARS ACCURACY

FOR HIGHER QUALITY SIDE SCAN SONAR DATA

Recent years have seen a growing call for more (and better) seafloor data. There are a multitude of reasons for the demand, including the importance for surface and subsea navigation that affect global commerce; trade and defense; rapid transition towards renewable energy from offshore wind; and keeping up with today's lightning-speed telecommunications, which requires accurate information from the seabed for laying underwater cables, pipelines, and other subsea structures.

Fisheries and aquaculture conservation and management also require a better understanding of behavior of ocean currents to improve the models that forecast future climate change. The race is on, deploying uncrewed vehicles and towed platforms to map the seafloor more accurately, faster, and with less expense. AUVs and ROVs are being designed to be smaller yet more functional. And Side Scan Sonars and magnetometers – the standard mapping solution for geotechnical and geophysical surveys – are now expected to provide higher quality data from the seafloor.



Courtesy of iXblue

Within that context and to respond to those new challenges, a leading Side Scan Sonars manufacturer wanted to improve the heading, roll, and pitch accuracy of their tow-body sonars. The final aim was to reach higher imagery data quality, and better operational efficiency for their end-clients around the globe.

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

"Our partner needed to improve the heading accuracy of one of their towed sonar solutions in order to obtain much higher quality imagery data than what they were used to providing, as per a specific request from their client, a major survey company," explains Shayan Haque, Business Development Manager at iXblue, Inc.

"They were convinced that the MEMS and Magnetometer AHRS technology they were using until then would not be enough. They had to turn towards Fiber-Optic-Gyroscope (FOG) technology and – being familiar with iXblue Phins C3 performance – they asked us if we would be able to meet the required specifications and have a product ready three months later."

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

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

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

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

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

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

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

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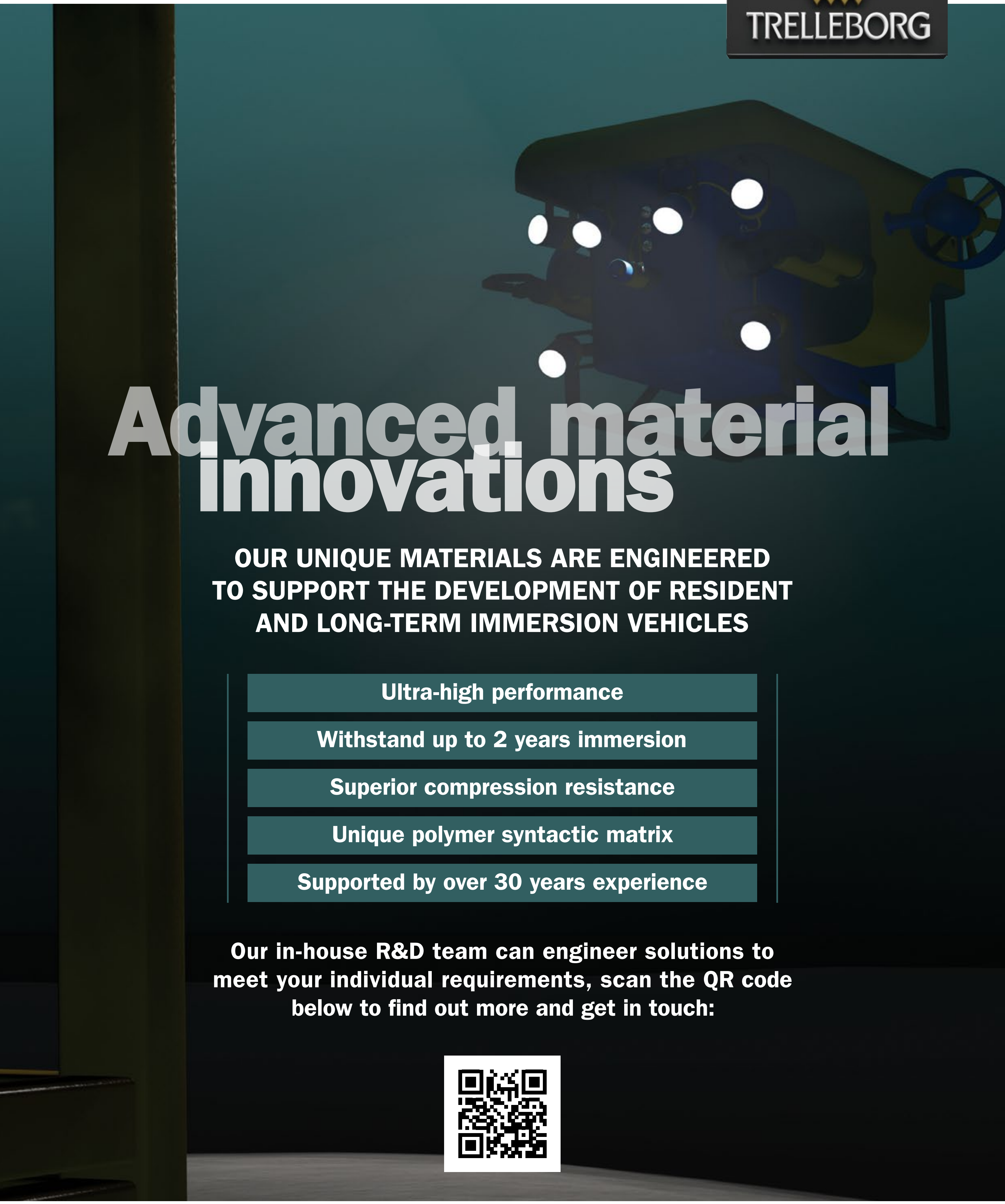

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ARCS CANADA'S FIRST AUV

By Bruce Butler, P.Eng.

In 1982, the Canadian Hydrographic Service (CHS) identified the need to perform cost-effective hydrographic surveys in Canada's Arctic waters. In 1983, CHS awarded International Submarine Engineering Ltd. (ISE)—based in Port Moody, BC—a contract to design and build an underwater vehicle that would meet those survey needs.

Named the Autonomous Remote Controlled Submersible, ARCS was originally considered an "autonomous ROV" (hence its name) but was soon referred to as an AUV. ARCS was not the world's first AUV; that honour falls on the University of Washington Applied Physics Laboratory and their SPURV vehicle back in 1957. ARCS was, however, Canada's first AUV.

VEHICLE DESIGN

ARCS is torpedo-shaped, rated for 300m depth, with a length of 5.2 metres, a diameter of 82 cm, and weighed 1360 kg. A second, option battery hull section increased the length to 6.4 metres and weight to 1820 kg. It was propelled by a single stern propeller powered by a pair of independent, direct-drive brushless DC motors. Vehicle maneuvering was via a pair of horizontal fore planes and four stern planes ("+" configuration).

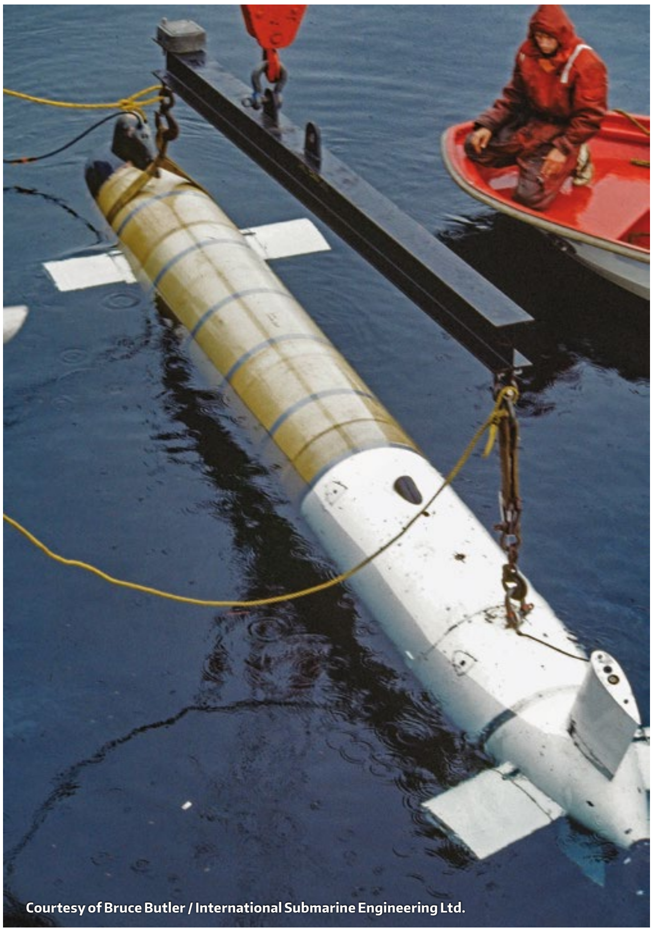
ARCS could run at 5 knots for 7 hours on a single, 10 kWh bank of rechargeable NiCd batteries. When outfitted with the optional second battery hull section, endurance was roughly doubled.

CONTROL SYSTEM

In the early 1980s, research into vehicle control systems was in its infancy and embedded computer hardware was large, costly, and had little processing power or memory. ARCS needed a control system that would meet the demands of under-ice missions, and ISE engineers came up with a novel solution. Drawing on the experience of one staff member who was a former submarine captain, ISE modelled the control system on the command hierarchy of a manned submarine. The control software would reside on a bank of three Intel 8086-based, single-board Multibus-II computers running the RMX real-time operating system.

The Engineering computer ("Eng") handled the vehicle's engineering functions such as thruster motor, dive planes, and most sensors. Eng also accepted data from the obstacle avoidance sonar and determined the appropriate avoidance maneuver. The Navigation computer ("Nav") interfaced with the navigation sensors to determine the vehicle's attitude and position. It also determined the heading and depth setpoints needed to steer towards the current mission waypoint (and

Courtesy of Bruce Butler / International Submarine Engineering Ltd.



Courtesy of Bruce Butler / International Submarine Engineering Ltd.

sent them to Eng). The Conning computer ("Conn") acted as the submarine captain, controlling the vehicle's operational mode, communicating with the operator console and processing manual commands from a human operator.

To provide the reliability needed for under-ice missions, a second, duplicate computer bank was provided. A separate Fault Tolerant Monitor board (FTM), comprising three independent processors that monitored the two computer banks, majority-voted to decide which computer bank was in control.

COMMUNICATION

Although ARCS was expected to be autonomous, a custom acoustic telemetry system, designed specifically for under-ice operation, was developed for vehicle monitoring and remote control. Using frequency-shift keying and triple diversity to overcome multipathing, this telemetry system provided reliable, 50 bps full-duplex communications at up to 10 km range.

NAVIGATION

ARCS navigated primarily via dead reckoning, using a north-seeking mechanical gyrocompass for heading and a Doppler sonar for ground and water speed. The dead reckoning solution was augmented with an onboard long baseline acoustic positioning system that measured range to multiple transponders deployed below the ice cover. Together, these two systems provided a position accuracy of ±5 metres.

Courtesy of Bruce Butler / International Submarine Engineering Ltd.

To operate under-ice, an AUV must be able to detect, then avoid an obstacle such as an ice keel or seamount. ARCS had eight echosounders mounted in the bow behind an acoustically transparent dome. These overlapping sonars acted as "cat's whiskers," allowing detection of obstacles up to 128 metres away. When operated in receive-only mode, these sonars were used to detect a homing beacon deployed below the ice, allowing ARCS to steer towards its recovery ice hole.

MILESTONES

It took ISE only two years to design and build ARCS. From January 1985 to February 1986, ARCS became fully functional, performing hundreds of manual and autonomous runs during sea trials in local BC waters.

In March 1986, ARCS completed its first autonomous hydrographic survey, travelling over 9 kilometres. These trials culminated with an obstacle avoidance test wherein the survey grid was purposely laid out to intersect the shoreline. While performing the hydrographic survey, ARCS detected the shoreline as an obstacle and steered to avoid it, eventually terminating its current survey line and moving onto the next line.

Funding for this project ran out in mid-1986, so ARCS never got to operate in the Arctic waters it was designed for. However, ARCS turned out to have considerable lifespan as a platform for research into autonomous vehicle technologies.

FOLLOW-ON WORK

In 1987, ISE re-activated ARCS to support a Johns Hopkins University Applied Physics Laboratory-funded effort to develop an AUV mission planner.

In 1990, ARCS was used to demonstrate autonomous cable-laying in support of the Canadian Department of National Defence's (DND) Cold War program codenamed "Spinnaker," the planned deployment of a prototype acoustic listening post on the seafloor in Canada's Arctic waters. The success of these demonstration trials gave DND the confidence to green-light Project Spinnaker, which included the development of a larger, mission-specific AUV known as Theseus.

Courtesy of Bruce Butler / International Submarine Engineering Ltd.

In 1991, ISE and DND scientists used ARCS to collect the dynamics data needed to develop a hydrodynamic model for Theseus vehicle design. These trials comprised putting the vehicle through a sequence of radical maneuvers while collecting attitude data. So radical, in fact, that on one dive, the vehicle broached vertically halfway out of the water, nose-first.

In 1992, DND scientists outfitted ARCS with sidescan sonar to investigate whether an AUV could be used for route survey in support of mine countermeasure operations.

ARCS remained busy throughout the early 1990s supporting Theseus vehicle development. ARCS was first used to develop, debug, and sea trial the hardware and software for ISE's generic vehicle control system. It then was used to test the Theseus high-accuracy navigation system: a north-seeking ring laser gyro-based inertial navigation unit coupled with a state-of-the-art Doppler sonar. Together those sensors provided an accuracy of better than 1% of distance travelled. ARCS was also used to test out other subsystems and sensors destined for Theseus.

In 1993 and 1994, ISE outfitted ARCS with an AluPower 60 kWh aluminum-oxygen fuel cell. This air-independent system allowed ARCS to run autonomously and continuously for 35 hours.

In the fall of 1996, ARCS was re-purposed as a data collection platform by Simon Fraser University's Underwater Research Laboratory. ARCS was outfitted with a SeaBird CTD and used to measure water temperature and salinity gradients by transecting the waters off the Burrard Thermal Generating Station, located at the eastern end of Vancouver's Burrard Inlet.

ARCS took a well-deserved rest until the late 1990s when it was outfitted with a set of bow-mounted echo sounders to evaluate whether an AUV could map the underwater portion of icebergs off Canada's east coast. This project ended with ARCS successfully circumnavigating and mapping a small island (the simulated iceberg) in BC waters.

In 2002, Memorial University of Newfoundland sponsored a project wherein ARCS was outfitted with a mass spectrometer to evaluate whether an AUV could be used to detect chemical plumes in the water column.

In 2003, the ARCS tail section underwent hydrodynamic testing at the University of British Columbia's towing tank to help optimize the hull shape for ISE's new Explorer-class AUVs.

SUMMARY

The Canadian-made ARCS AUV has a rich history, having made valuable contributions to the development of AUVs, including several "firsts." It was the first commercially built AUV and the first to autonomously perform a hydrographic survey. It is arguably also the world's first "true" AUV—the first underwater vehicle in marine history to operate independent of a command/control telemetry link and autonomously avoid obstacles.

ARCS has evolved over its nearly 40-year life and is expected to continue to support the development of Canadian AUV technologies into the future.

ABOUT THE AUTHOR

Bruce Butler worked at International Submarine Engineering Ltd. for fourteen years and was involved in the development of ISE's ARCS, DOLPHIN, and Theseus vehicles. Want to learn more about ISE's history? Bruce has written Into the Labyrinth: The Making of a Modern-Day Theseus, which is available in print, e-book, and audiobook formats: **www.theseusbook.com**

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- Weight: 104kg (air) / 82kg (water)
- Depth Rating: 3,000 msw

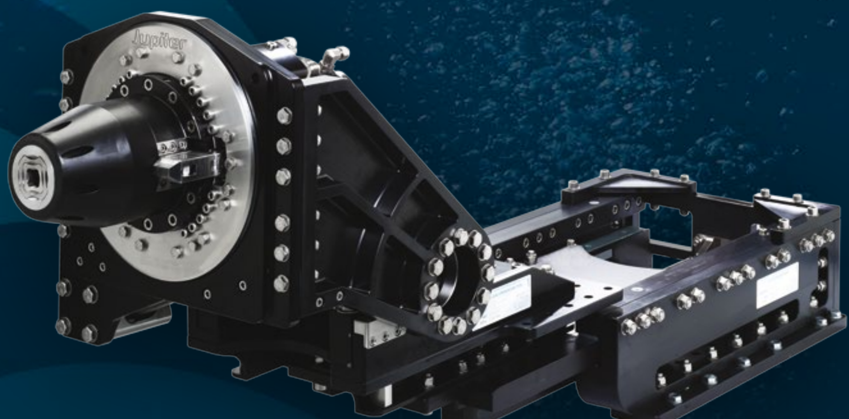

Image right shows FLOT mounted to optional Jupiter FLOT Extender, which can provide up to 300mm of forward advance.

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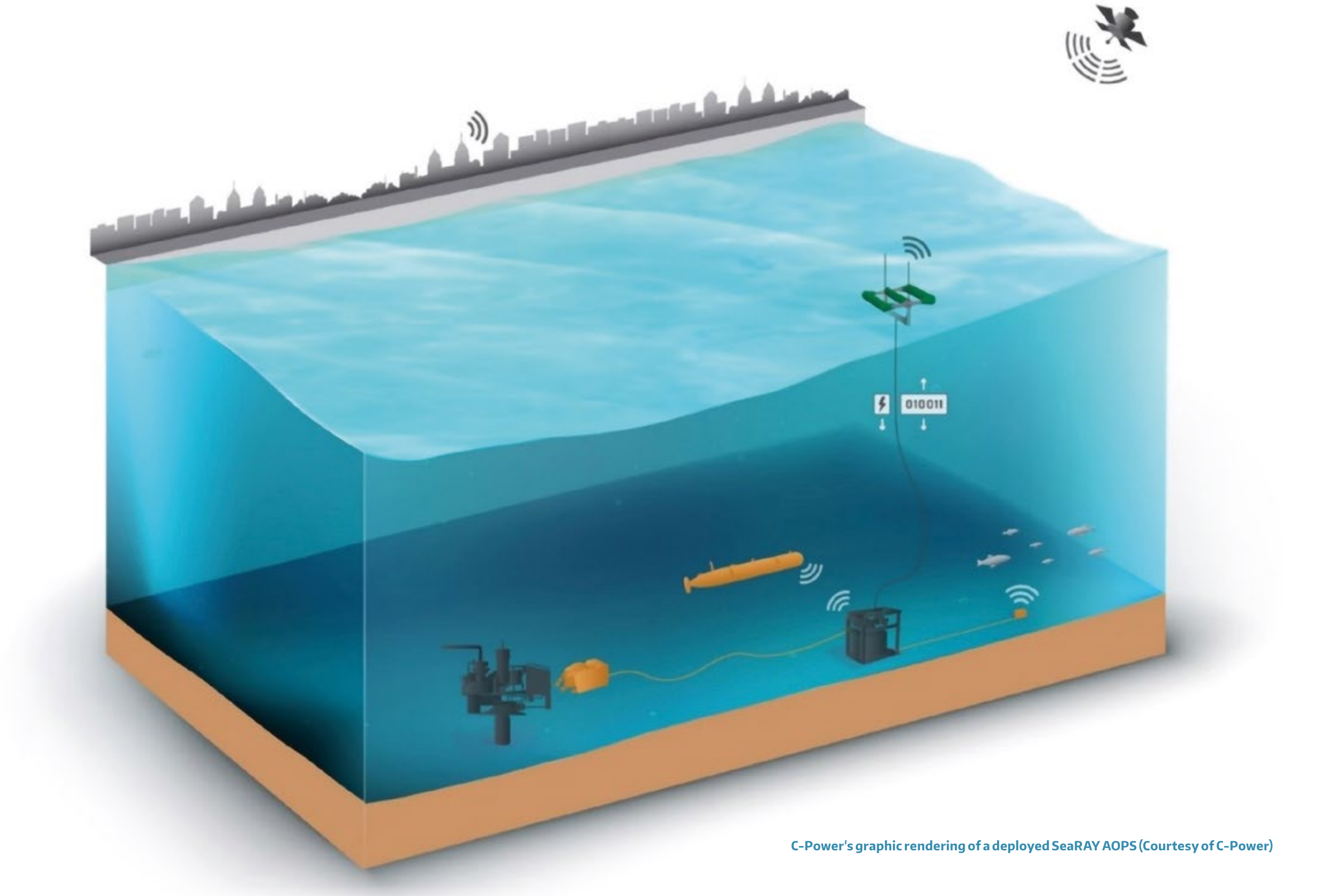


C-Power's graphic rendering of a deployed SeaRAY AOPS (Courtesy of C-Power)

POWER IN AND DATA OUT

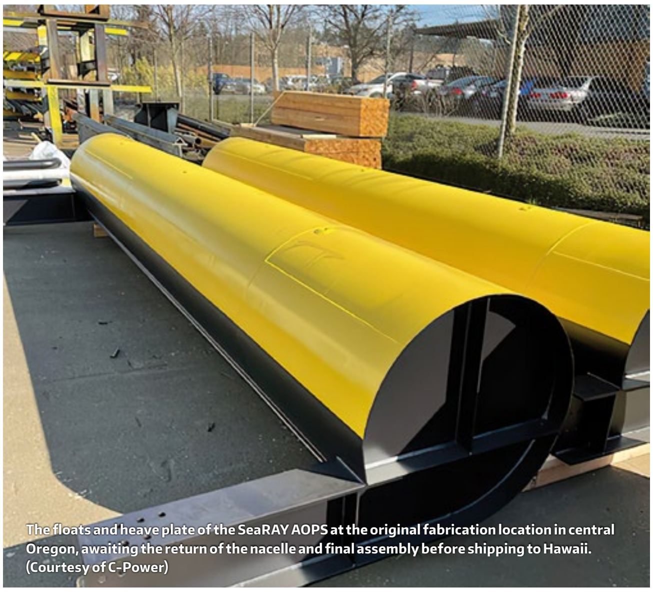
HOW C-POWER'S SEARAY AOPS STARTS THE FUTURE OF THE OCEAN ECONOMY TODAY

On a warm, sunny morning in July, nearly a dozen officials from C-Power, the U.S. Department of Energy (DOE) and the National Renewable Energy Laboratory (NREL) crowded around a large, yellow metal tube. Arrival of this tube—a nacelle, actually, undergoing a series of pre-deployment tests at NREL's Flatirons campus in land-locked Colorado, USA—was also eagerly awaited by members of the U.S. Navy.

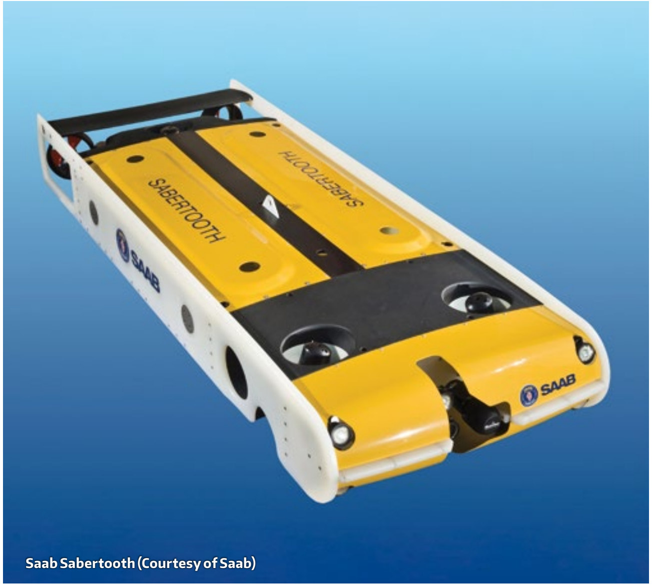
What coalesced the interest of these powerful forces advancing cutting-edge innovation, not to mention numerous other public and private industry partners? The short answer is to find out how clean, abundant power best gets produced offshore. The longer answer starts on the campus of Oregon State University (OSU) in Corvallis, Oregon.

THE MARKET WAS SPEAKING. IT WAS ASKING FOR POWER IN AND DATA OUT.

From a technology licensed over a decade ago from OSU, C-Power looked to develop a cost-effective system to convert ocean wave energy to electricity. This original technology concept was intended to provide utility-scale power for homes and businesses.



The floats and heave plate of the SeaRAY AOPS at the original fabrication location in central Oregon, awaiting the return of the nacelle and final assembly before shipping to Hawaii. (Courtesy of C-Power)



Saab Sabertooth (Courtesy of Saab)

But it was not until C-Power partnered with the University of Washington Applied Physics Lab in 2016 on a U.S. Defense Advanced Research Project Agency, better known as DARPA, that the light bulb went off on customer needs at the other end of the power spectrum. While utility-scale power from offshore wave energy farms remains an important goal, the DARPA project highlighted a different customer problem and revealed the defense and security sector's need for resident energy sources for conducting critical marine operations in remote locations. The defense industry was not alone in this need.

Following the DARPA project, C-Power conducted thousands of hours of research and fact-finding with global leaders in the ocean economy and heard the same message over and over: "Our customers want lower cost, lower complexity, safer solutions. We are developing innovative new hardware and services to meet those needs, but a lack of reliable energy offshore is a stumbling block. We need to power our remote assets and get data in and out without using crews and vessels, but we also need to reduce our carbon footprint. There's really no way to do that today.", said Reenst Lesemann, CEO of C-Power.

Said another way, the requirements of producing energy for consumption offshore (a lot of people, capital and carbon) means defense and security, oil and gas, scientific research and other operations are currently tied to a manned operational model; one that's expensive, inefficient, high emitting, and sometimes very dangerous.

Even without the power supply question being resolved, established companies and startups alike have seen the opportunity for new autonomous, digital, and electric technology innovations to enable the transition away from a shore-dependent operational model. Within the ocean economy, tremendous effort and resources are being devoted to upgrading existing hardware, extending the life and operational profile of existing generation assets, and creating new resident systems. The output of this work is a new generation of mobile and static assets that will be able to:

- Be more autonomous and persistent, while performing increasingly complex tasks
- Collect, process, and transmit richer datasets more often
- Enable the drive toward electrification and net–zero operations
- Do any or all the above more cost-effectively, more safely, and with less environmental impact

But until now, the cart has come before the horse. The problem is that the ocean is a power desert, and a communication desert, too, for that matter.

THE MISSING PIECE OF THE PUZZLE

C-Power's answer to this problem came in the form of the autonomous offshore power system (AOPS), which Peter Erkers, sales director for underwater systems at Saab Dynamics AB, has called the "missing piece of the puzzle" for enabling a wave of innovative technologies that will help transform the ocean economy.

An AOPS enables two critical advances to solve the "power in and data out" problem:

1. They provide the local energy and real-time data and communications services needed to reliably support remote systems and operations.

2. They do so with an in situ, clean energy source (i.e., no topside vessel).

The configurations of an AOPS are incredibly flexible, allowing them to meet the needs of a wide array of customer uses across industries. In simple terms, think of an AOPS as the combination of a remote charging station, a data server, and a cell tower, but out in the ocean. These new marine energy systems are easy to transport and deploy. They are platforms that enable

The SeaRAY nacelle at the National Renewable Energy Laboratory (NREL) Flatirons Campus in Colorado. The nacelle is the cylinder in the middle of the image. At NREL, it's tipped on its side for ease of access. The hatch openings normally face up when deployed. The purpose of the NREL testing is to ensure all systems and components are ready to go into the water in Hawaii. NREL has built a new dynamometer (on red brackets to the right) for testing smaller wave energy systems, like the SeaRAY. (Courtesy of C-Power)

deployment of mobile and static assets on the surface or seafloor for weeks, months or years in shallow- and deep-water locations.

Importantly, they enable a number of use models: equipment purchase or lease, or a compelling model of providing "energy-and-data-as-a-service," allowing a customer to pay by the kWh consumed or MB transmitted.

Because of their flexibility, the systems are positioned to transform the ocean economy through four primary use cases:

1. AUVs and ROVs: Supporting underwater vehicles with local power and data communications from an AOPS carries a strong value proposition for customers, as unmanned permanent and campaign-based monitoring, inspection, and light interventional tasks offer substantial cost and carbon savings. An AOPS enables these highly sophisticated vehicles to fully deliver on their resident capabilities offshore, where they can be deployed for research and new scientific discoveries, inspecting subsea pipelines, or protecting harbors and ports without a topside vessel. Support for heavier duty systems is also coming.

2. Sensors and Monitoring Equipment: A large market opportunity for AOPS deployment is powering the vast and ever-growing array of sensors and monitoring equipment used in the ocean across all industries. For example, storage of captured carbon deep below the seafloor will require both mobile and fixed monitoring equipment to ensure the integrity of the reservoir. The power to keep these systems running continuously in the middle of the ocean, transmitting the collected data to the ocean surface and then to the cloud in real-time, will come from an AOPS. The same concept applies for oceanographic research sensors collecting met-ocean data or sensors monitoring hydrocarbon emissions from an offshore field.

3. Operating Equipment: When energy is scarce or too expensive offshore, a local AOPS can be the answer for brownfield upgrades and life extensions, emergency or redundant power needs, or all-electric greenfield developments. And a benefit is the ability to add or improve bi-directional data flow and bandwidth for needs such as getting real-time, condition-based monitoring and performance data to where it's needed.

4. Unmanned Surface Vessels (USV): USVs are coming to our oceans, just as electric vehicles have proliferated on land. One obstacle is recharging and refueling. As it stands today, a USV will have to go to port to get recharged. An AOPS can act as an offshore recharging station, substantially improving the utilization and efficiency of the USV by avoiding unnecessary trips to port and providing a "power-to-X" capability for battery or fuel cell recharging.

COMING TO OCEANS NEAR AND—JUST AS IMPORTANTLY—FAR FROM YOU

Many in the ocean economy are looking and waiting for clean power solutions to emerge and help enable the transition away from the current operational model through new capabilities not possible today.

But thanks to a groundswell of support from government programs, such as the U.S. DOE's Water Power Technologies Office or the U.K.'s Net Zero Technology Centre, and partnerships with established private industry players, the technology is here. The SeaRAY AOPS is real and it is here today.

In fact, a first system was sold earlier this year. A second, larger system—the one the yellow metal tube in Colorado belongs to—is part of an application demonstration this year. A SeaRAY AOPS will be deployed for six months in partnership with the DOE and Navy at the Navy's Wave Energy Test Site (WETS) off Marine Corp Base Hawaii.

People at NREL: Pictured from left to right: Dan Cahill (DOE), Scott Lambert and Rebecca Fao (NREL), Reenst Lesemann (C-Power), and Erik Mauer (DOE). (Courtesy of C-Power)

The SeaRAY AOPS at WETS is a moored configuration consisting of a surface energy generation system; a single, combined mooring, data, communications, and power cable; and a seafloor base unit that provides energy storage and power and data interfaces for operation of mobile and static assets. It is designed to survive the 100-year storm off the U.S. Pacific Northwest coast and is easily transported worldwide in standard ocean containers. It will be deployed at WETS with a small, lightly crewed vessel.

Developed under a $4 million DOE-sponsored research and development program, the SeaRAY AOPS incorporates cutting-edge technology from several industry-leading partners and will support several mobile and static assets during the groundbreaking deployment. Technology partners include:

- EC-OG, providing the battery energy storage and gravity anchor unit
- EOM Offshore, providing the combined mooring, data, communications, and power cable
- BIRNS, providing subsea connectors and cable assemblies
- Vicor, providing power conversion technology to convert pulsed ocean wave energy into electricity
- NREL, providing testing services and its MODAQ supervisory control and data acquisition system
- Harris Thermal, providing steel fabrication and assembly
- SunWize Power and Battery, providing design and assembly of electronic systems within the nacelle
- Malin Group, providing design services

As excited as C-Power is to partner with these talented suppliers to create an innovative technology that is by far the industry leader, what's more exciting is the commercial capabilities the AOPS will demonstrate. During the six-month demonstration, the SeaRAY will support the following payloads:

- A double-hull Saab Sabertooth hybrid AUV will operate in untethered mode, without a topside vessel, for three weeks. The Sabertooth will conduct detailed bottom surveys and collect environmental data. It will be equipped with an R2Sonic Sonic 2024 multibeam echosounder, an ASL Acoustic zooplankton and fish profiler, a Voyis Insight Pro Laser Scanner, and a Sonardyne BlueComm 100 wireless, high-speed modem to transfer data underwater at high speeds. Hibbard Inshore will remotely program and monitor from shore during this first ever instance of an in situ renewable energy system supporting a subsea resident vehicle. The Sabertooth's docking cassette connects to the AOPS' seafloor power and data interfaces via an umbilical. Missions will be downloaded from the cloud through the AOPS to the AUV, which will perform its mission, return to the dock, download its data for upload to the cloud, recharge and then repeat the cycle until the deployment is complete.

- A static seafloor BioSonics long-range subsea environmental monitoring system will be deployed for the entire six months, sending data real time to the cloud. The BioSonics echosounder will also serve as an intrusion detection system during the trial. The Sabertooth and the BioSonics assets will be supported with energy and data simultaneously.

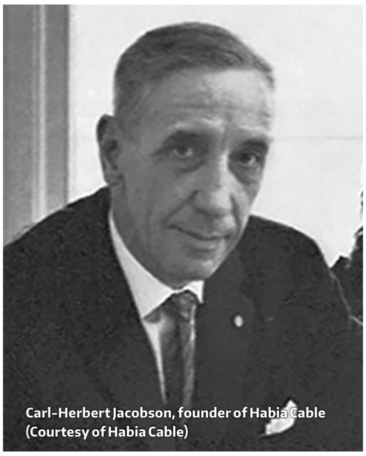
- A Fugro seafloor met-ocean data-gathering package will be deployed for four months, including an integrated Franatech methane leak detection sensor.

Back at NREL's Flatirons campus, C-Power and NREL staff and engineers track the progress of validation and verification testing; a critical step before the smart parts of the AOPS would be packed up and shipped to Hawaii, and from there, into the ocean.

Disruptive innovation comes in many shapes and sizes. It's easy to look at the SeaRAY at NREL and see a yellow metal tube. The DOE, Navy, NOAA, and a growing number of private industry leaders see the technology that will power the blue economy through a wave of transformation.

80 YEARS OF HABIA CABLE:

FROM SUBMARINES TO ROVS



Carl-Herbert Jacobson, founder of Habia Cable (Courtesy of Habia Cable)

Habia Cable are celebrating their 80th birthday this year. This is a special birthday for a special company that was started back in 1941 by Carl "Charlie" Herbert Jacobson, as Hammarby Bakelit Industries (Habia for short), based in the Hammarby dockyard in Stockholm, Sweden. The company originally manufactured components from Bakelite, the polymer of the day. Thanks to the foresight of its founder, Habia went on to become the first company in Europe to manufacture components and cables in PTFE, a material more known as Teflon®.

Today, Habia Cable is a custom design and production partner for specialised cable and connectivity needs all over the world. The company has four production facilities including R&D; in Sweden, China, Germany and a specialized harness site in Poland. Headquarter is located in Upplands Väsby, nearby Stockholm, and the company employ just above 500 people globally.

ROV Planet talked to Elisabeth Oesterlund, Senior Design Engineer with more than 30 years of experience working with cable solutions development at Habia, to find out more about this iconic Swedish company.

RICHIE ENZMANN: Hi Elisabeth, we'd like to wish Habia Cable a happy 80th birthday! Please tell us a bit about the history of the company. How did it all start?

ELISABETH OESTERLUND: Thank you, Richie! It all started with Carl "Charlie", the founder of our company, who was a chemical engineer coming from an entrepreneurial family and very interested in the material Bakelite. He had an exceptionally good relationship with DuPont, the major US chemical company that was very innovative already in those days. DuPont encouraged companies to develop different types of components and applications with these materials that they provided, and Habia manufactured various Bakelite components for many industries.

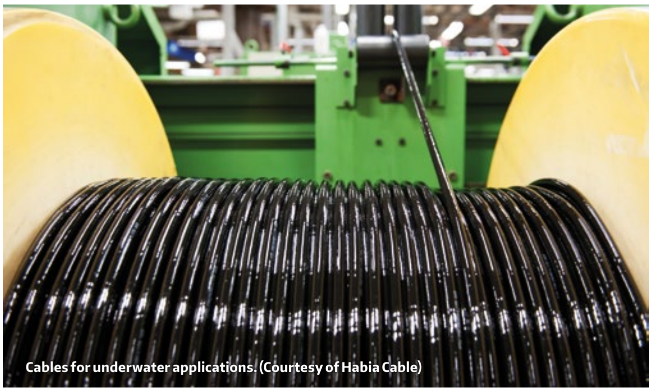
After WWII, DuPont introduced a new material called polytetrafluorethylene, PTFE, a polymer with remarkable properties, resistant to anything; like corrosive acids and solvents, and with very low friction. You probably know it by its commercial brand name, Teflon®, used in many products today. At the time, Charlie had the foresight that this material could be used even more widespread, so he set up a different type of factory at the family farm Brantshammar, north of Stockholm, in the middle of the 50s. Here he started making different components out of PTFE. One of the main products were the high-pressure braided PTFE hoses. This was the first step to start manufacturing electrical cables in 1957, when the first prototypes were made. Then in the 60s, this business was commercialised by Charlie's son, Carl-Bertil 'Obi', and new cable factories were set up in Europe. In short, the beginning of cables and cable manufacturing at Habia.

Elisabeth Oesterlund, Senior Design Engineer (Courtesy of Habia Cable)

Back in the 50s, Habia was the first company in Europe to use the material PTFE in manufacturing of industrial components. (Courtesy of Habia Cable)


In the 80s the cable production in Sweden expanded and moved from Brantshammar, Knivsta, to a new facility in Söderfors. It was here the development started with creating a new shipboard cable standard for the Swedish Navy, still valid today. (Courtesy of Habia Cable)


Courtesy of iStock


Cables for underwater applications. (Courtesy of Habia Cable)


Cables for underwater applications. This is a custom, neutral buoyant tether cable for a specific ROV. (Courtesy of Habia Cable)

RE: That's very interesting and clearly shows the entrepreneurial spirit of the family that Habia was born out of. How did the company move into the submarine defence sector?

EO: Well, in the mid-60s this operation expanded very quickly because Habia had the benefit of creating longer lengths of cables, which turned out to be suitable for military aerospace applications. Then in the late 70s, the family sold the company to the investment house Sponsor AB, who expanded the cable production to Söderfors, Sweden. This was also the starting point of manufacturing cables to a new class of submarine vessels built for the Swedish Navy.

With our legacy in the defence sector, the Swedish Ministry of Defence (FMV) asked us for help to improve and upgrade the existing rubber cables on their fleet, as they were thick and rigid, not very resistant to oils. The cables Habia developed and supplied was a new generation of cables with modern materials, in comparison to the traditional ones using rubber in insulation and outer covering.

The new cables with improved properties offered benefits like long lifespan, trimmed dimensions and low weight, which set a new standard for shipboard cables in the industry. The new cable concept also enabled advanced harnesses with penetrators, important for the submarines' functionality.

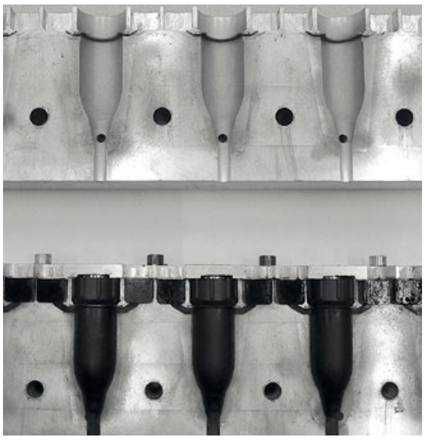
RE: I guess during this period of time many navies went through similar upgrade programmes.

EO: Yes. During end of the 90's, the next generation of shipboard cables were developed to meet the demands for improved safety in case of a fire. This required the use of so-called halogen free, low smoke materials, important in order to reduce the amount of toxic and corrosive products released during a fire. Habia's high performance cables for shipboard use became then even more established, acquiring classification approvals. As example, certification to the British MOD Naval standards was acquired, enabling Habia to supply cables to the British Royal Navy. Defence cables, both for land and sea, have been one of our company's niches from the year 2000 up until now.

RE: That is a remarkably interesting history that Habia have. But let's take a look at some of the ROV applications too. How did the company actually get into making cables for the ROV industry?

EO: Around 2005 we started developing custom subsea cables to smaller ROV's requiring trimmed, low-density cables. At the time, we created the first smart concepts for umbilicals where the combination of electrical properties, flexibility, mechanical strength and neutral buoyancy was superior requirements for these applications.





Habia's factory in Lubiezsyn, Poland, develops cable systems and harnesses for a range of defence, marine, and offshore applications – an expertise that goes back to the 80s. (Courtesy of Habia Cable)

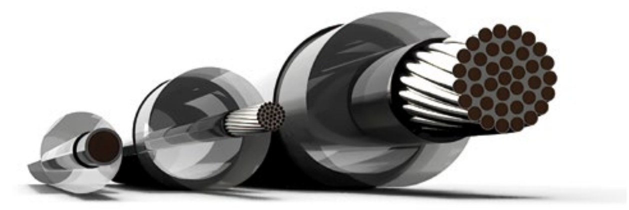
This was the start and soon we were able to make more sophisticated umbilicals adding optical fibres integrated into traditional copper core cables. Since then, several ROV customers have been buying Habia's tethers, umbilicals, cables and cable systems in various configurations, because we can supply for a vast range of applications – even deep-sea ones. Our company has the knowledge to design and manufacture these cables as per the requirements of the customers, and the ability to test them in our in-house pressure chambers. We also offer extensive qualification testing programmes if needed.

Of course, the cables supplied by Habia are not only neutrally buoyant cables, but also cables mounted onto the vehicle. Cable solutions for all electrical needs, i.e. lighting, camera, video, tools, need to comply with complex requirements outside electrical performance, like water and pressure resistance, flexibility and high-quality connectivity.

RE: How about some of the other underwater applications out there?

EO: Outside the ROV world, many of Habia's customers produce systems for sensors, sonars and seismic applications. For these, termination compatibility with connectors and penetrators, offering a watertight seal for cable/harness to penetrate a bulkhead is also very important to consider. They also need to be watertight and very often they have specific requirements to go as high as possible in the electrical current ratings, but with the smallest cross section possible.

Obviously, the electrical performance of the cable is most important when it comes to an application. A noticeable trend are increased demands for power capacity and transmission of signals at higher frequencies, which put a lot of requirements on the cable and the control of production. It's often a challenge to combine all the different requirements, and Habia's extensive engineering experience across cables and harnesses is needed to find the best possible solution. But that is what we're good at as a custom solutions provider. We are often involved in our customers' product development, to help finding the most optimal cable solution early in the process. Examples of newer, exciting application areas are the tidal and wave power turbines, where we have developed complete solutions for cables and connectors.



Habia Zeroarc™ is a ground-breaking insulation system that allows us to create compact, medium to high voltage cable solutions. (Courtesy of Habia Cable)

RE: I've heard that Habia is working on a new technology that could also be used in submersible applications. Can you please tell us more about that?

EO: Yes. That is our new Zeroarc™ technology. This is a unique design for applications requiring medium and high voltage cables with higher operating voltages combined with the need for compact, reduced sizes and wide temperature performance. Cable solutions created by the Zeroarc™ concept is free from voids and impurities, resulting in a cable without partial discharges – a not wanted effect when applying higher voltages. For the use of submersibles using this technology in the power cores, they can handle higher temperatures, and as such can carry more current in a thinner cable. As a result of using the Zeroarc™ concept, future ROV cables/umbilicals could in turn become lighter, smaller, and easier to handle. Further on, Habia has also developed solutions for splicing and connectorization in the concept.

RE: Thank you for explaining the history of Habia and sharing your expertise to our readers and us. It's been a pleasure talking to you, Elisabeth!

LOOKING INTO THE FUTURE

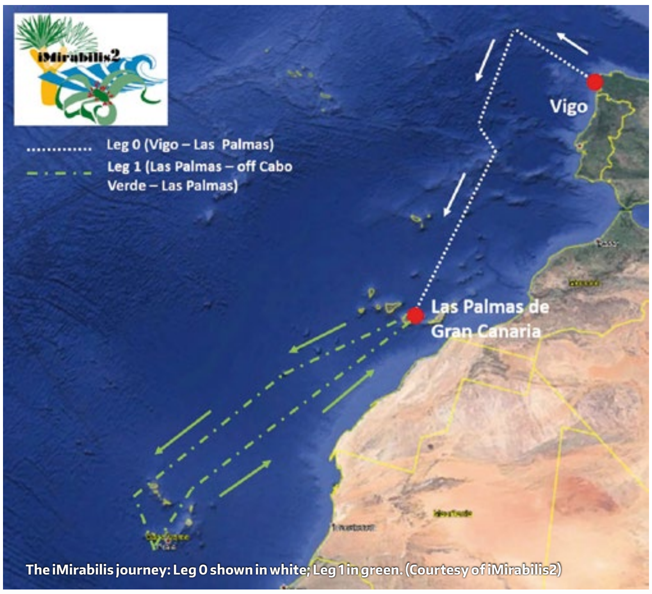
The company hopes that this new Zeroarc™ technology can open up even more opportunities, since it enables very powerful cable solutions that can solve the power needs of the future. Over the last 80 years, Habia continued to experiment, invest, and invent. Today, Habia is a global leader in custom cable solutions for the world's most demanding applications. They like to think that if Carl could see them now, he'd agree that his innovative and entrepreneurial spirit still lives on!

iAtlantic
INTEGRATED ASSESSMENT OF ATLANTIC MARINE ECOSYSTEMS IN SPACE AND TIME

iATLANTIC PROJECT

A SCIENTIFIC RESEARCH MISSION TO EXPLORE THE DEEP-SEA AROUND CABO VERDE

The iMirabilis2 expedition is a 6 week-long scientific research mission that will explore the deep-sea ecosystems of the Atlantic Ocean around Cabo Verde. During those 6 weeks, the scientists on board will use state-of-the-art equipment to undertake a number of experiments and surveys that will reveal information about the inhabitants and physical conditions in the water column and at the seafloor. In addition, a large part of the activities during the expedition will be dedicated to training and skills development for early career marine scientists.



The iMirabilis journey: Leg 0 shown in white; Leg 1 in green. (Courtesy of iMirabilis2)

After leaving port in Vigo on 23 July 2021, the ship will sail a roundabout route southward to Las Palmas in the Canary Islands – this is Leg 0. This journey will take about a week, and during this time scientists from EMEPC and other research institutes will undertake surveying and sampling of some of the geological features on the seafloor in this part of the Atlantic, using the Luso ROV. At the same time, some of iAtlantic's early career researchers on the ship will undergo intensive training in the use of ROV technology. Also on board will be a small team of seabird ecologists from the NGO Projecto Vito in Cabo Verde, who will use this time at sea to observe seabirds. This expedition is an excellent opportunity for them to get hands-on training and experience in seabird surveying and census techniques, as well as collecting valuable new data on seabird abundance and distribution in this area of the Atlantic.

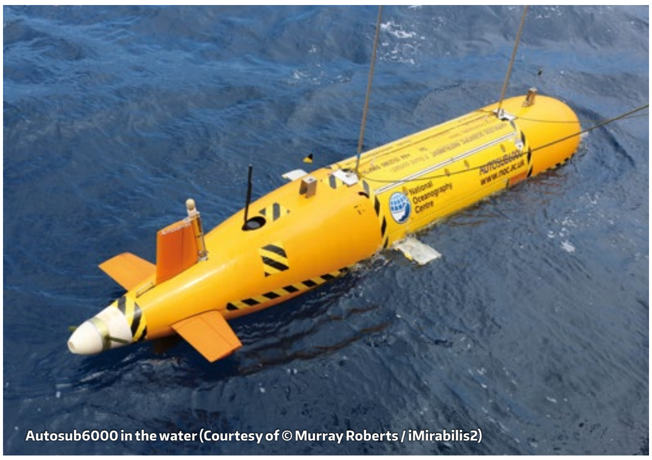
Research vessel Sarmiento de Gamboa in port in Vigo, 19 July 2021 (Courtesy of © Nuno Vasco Rodrigues / CSIC / iMirabilis2)

THE LUSO ROV

During the iMirabilis2 expedition, the Portuguese ROV Luso will be used. The Luso is a large ROV that weighs 2.4 tons and can go as deep as 6000 m below surface. It was acquired by Portugal in 2008 with the purpose of collecting geological samples from the seabed to support the Portuguese continental shelf proposal. So far, the Luso has performed about 245 dives in a total of about 1,000 hours of operation, down to a water depth of 3,250m.

Luso ROV in the water (Courtesy of © Murray Roberts / iMirabilis2)

During iMirabilis2, exploratory ROV transects of the seafloor will be conducted, with some stops when we want to collect samples of benthic organisms, plankton, water, and sediment. The taxonomy of the benthic organisms will be identified, and they will also be dated – some corals can be up to 4,000 years old! The ROV is equipped with laser pointers, which are necessary when the scientists want to scale the images taken by the cameras. Luso also has manipulator arms and a drawer with different compartments to collect samples. Data collected during the ROV transects will be visualised on the 3D bathymetry of the target areas, which is available for parts of the study area from previous missions.


Autosub6000 in the water (Courtesy of © Murray Roberts / iMirabilis2)

Luso is equipped with a video system that comprises a set of 6 cameras, including an ultra HD 4K camera that is used to record the entire dive. The video system is accompanied by an independent digital still camera that can take 10 Mpx photos with a flash – important in the low light conditions of the deep sea.

Launching the Autosub6000 (Courtesy of © Murray Roberts / iMirabilis2)

The video observations made during each dive will later be used in conjunction with the information from the camera recordings in order to confirm the presence/absence of species and to classify different types of seabed based on local bottom fauna. High-resolution bathymetry will be collected using the new multibeam system mounted on ROV Luso's frame.

In general, ROVs offer high sampling precision and allow the use of non-destructive data collection methods. The ROV Luso is equipped with two arms with different manipulators. Sampling accuracy is provided by a 7-function arm with a delicate claw, working together with a more multipurpose 5-function arm. This configuration is particularly suitable for sampling the hard rock substrate and delicate benthic fauna specimens.

Additionally, the ROV Luso can collect nine sediment corers (~30 cm long) per dive. Water samples can be stored in four Niskin bottles, and a CTD profiler with extra sensors can provide good characterization of the entire water column, collecting data during the dive down to the seafloor and on the way back to the surface (including temperature, salinity, pressure, oxygen concentration, turbidity, pH, redox potential, fluorescence, CO_2 and CH_4).

THE AUTOSUB6000 AUV

The AUV used during iMirabilis2 is the Autosub6000, which was designed and developed at the National Oceanography Centre in the UK. It is a large yellow torpedo, about 5 metres long and weighing 1800 kg when out of the water, and is called Autosub6000 because it can operate in water depths of up to 6000m. It is launched from the research vessel from a large gantry, and is powered by batteries. These last about 24 hours depending on the instrumentation on board and how fast the AUV moves, and they can be recharged once Autosub is brought back on board the research vessel after each dive.

During iMirabilis2, Autosub6000 will be used to carry out habitat mapping – exploring the ocean floor to map out the different types of habitat (e.g., rocky substrate, sandy sediment, coral reef) and what lives there. To do this, Autosub's acoustic instruments will collect detailed bathymetry data as well as acoustic images from backscatter data (an image generated by how sound waves interact with the seafloor surface). The structure of the sediment just below the seafloor can also be imaged acoustically using a sub-bottom profiler. Autosub also comes equipped with high-resolution cameras which will be used to collect photos and video footage that can be processed to build up a picture of the seafloor habitats and fauna.

Autosub6000 will also carry a number of other sensors that allow measurement of seawater properties such as temperature, salinity, current speed and other chemical parameters. Most excitingly, it will carry the new RoCSI eDNA sampler which samples environmental DNA in the water column.


ROV Luso (Courtesy of © EMEPC)

BENTHIC RESPIROMETER LANDER

The benthic respirometer lander is a device capable of conducting experiments at the seafloor on its own. We call these experiments 'autonomous in situ incubations'.

Heavy weights are attached to the legs of the lander, making it sink when put overboard. Once landed on the seafloor, a computer is programmed to start the experiments at a certain time. Benthic chambers (basically upside-down fancy plastic buckets) are pushed into the sediment by the computer and drive motors, sealing off a bit of the seafloor environment from the rest of the ocean. The computer then injects a little bit of food into the chamber, which is consumed by the organisms in the sediment, thereby using up oxygen, producing carbon dioxide, and regenerating nutrients.

Inside the chamber is an 'oxygen optode' which measures the change in oxygen concentration over the time of the experiment. Also, at certain time intervals during the experiment water samples are taken from inside the chamber by a syringe, effectively taking a snapshot in time of the chemical composition of the water.

After about 48 hours the computer closes the chamber doors (similar to those flexible garage doors) so that the sediment is now fully surrounded by the chamber. We then send a sound signal from the ship, which activates the releases. The releases open up upon hearing the sound signal, detaching the weight from the lander frame. Without the heavy weights the floats now provide positive buoyancy to bring the lander back to the surface.

At the surface the lander is recovered back to the ship, and the water and sediment samples are processed in the lab. The data obtained can tell us which organisms were involved most in eating the food, how much they have eaten, and how their activity changed the chemical composition of the seawater (oxygen, carbon dioxide, nutrients). This provides insight not only in which organisms were there, but also into what they were doing and how much of it they were doing, which is called 'ecosystem functioning'.

Mapping deep-sea ecosystems requires a multidisciplinary approach, using different technologies to gather data from well-defined target areas. By combining data from different sources – bathymetry and other parameters extracted from the multibeam (backscatter data), geological samples (rock and/or sediment), biological and water samples and other environmental parameters – it is possible to extrapolate the information over a wider area of seafloor using predictive mapping techniques.

iMirabilis2

THE MARINE ROBOTICS WORKFORCE OF THE FUTURE

BRIDGING THE TRAINING, SKILLS AND REGULATORY GAP

Huw Gullick, MD of NOC Innovations Ltd, and Associate Director Strategic Business Development at The National Oceanography Centre (NOC) challenges the need for diversification and regulation in skills of the marine science workforce.

THE NEED FOR SKILL DIVERSIFICATION IN THE MARINE INDUSTRY

Reskilling is essential for ensuring a smooth transition to marine autonomy. Technological advances are driving forward automation and we expect to see the driverless car on our roads in the not-too-distant future. However, we are more likely to see driverless vehicles operating in our ocean years before the driverless car becomes a common sight.

The National Oceanography Centre (NOC) is home to the Marine Autonomous and Robotic Systems (MARS) fleet, one of the largest and most advanced in the world, having benefited from a £10 million investment as part of the UK Government's 'Eight Great Technologies' initiative, and £16 million from the Industrial Strategy Challenge Fund.

Autosub6000 in the workshop at the NOC (Courtesy of NOC)

IN OUR RUSH TO ADOPT AUTONOMOUS VEHICLES, ARE WE FAILING TO UPSKILL OUR MARINE WORKFORCE TO ENSURE SAFE OPERATION?

Marine autonomy is helping to scale ocean science and undertake ocean observations in deeper seas, hard to reach regions whilst reducing our dependence on support ships. This in turn will help cut our carbon emissions and drive our ambitious net-zero targets.

With a switch towards autonomy comes the concern that jobs in the marine industry will be lost. However, with the workforce of engineers and technologists who develop, maintain and operate these high-tech robots integral to their success, this isn't the case. In reality, it means that new skills are entering and diversifying the marine labour market, presenting challenges, including the need for robust regulation and training.

A change towards Remote Operation Centres (ROC) will require engineers and technologists to have additional specialist training essential for ensuring expert knowledge of the equipment they are operating and the environment that they are working the equipment. The latter also presents a further opportunity for those who previously overlooked a career in marine science due to the need to spend time away at sea.

Whilst MAS will always need technologists and engineers, due to the increased use of machine learning and artificial intelligence in machine development, the need for software engineers and computer scientists has never been greater. Attracting delegates with the right skills provides a further challenge for the marine industry as it competes with industries traditionally perceived as more glamourous or financially rewarding. National and international organisations such as the NOC highlighting the unique role they play in the future of our planet, from both an environmental and economic perspective, may play a pivotal role in competing in these markets.

DEVELOPING RECOGNISED NATIONAL AND INTERNATIONAL STANDARDS

Compared with modern shipping and operations, marine autonomy is still in its infancy, so it is not surprising to see those equivalent standards, skills, and regulations for working in this industry are only just emerging. We, therefore,

A2KUI being winched into the water at Loch Ness - Oceanids Trials (Courtesy of NOC)

ALR being trialled at Loch Ness - Oceanids Programme (Courtesy of NOC)

face a concerning scenario whereby technology will outpace our ability to operate marine autonomous and robotic systems safely.

To match and exceed the capabilities of the technology, it is now necessary to expedient standards and regulations. To achieve this, regulatory bodies, industry operators and training providers must work hand in hand to agree on a sensible and scalable approach to standards and training and deliver programmes that accelerate regulation.

There have already been positive steps forward in this area, for example, the MASRWG, the MCA / DfT led MARlab project hosted by the NOC, that engaged industry partners with the Lloyd's Register Foundation Assuring Autonomy Programme. Progress bought by the funding given to MarRI-UK for Smart Maritime Land Operations should see regulators, academia and industry working together to deliver the technologies in consultation with the regulatory stakeholders.

FILLING THE SKILLS GAP AND DEVELOPING A RECOGNISED TRAINING PROGRAMME

As with regulation of marine autonomy, the pace of adapting maritime training for operating and maintaining autonomous equipment needs to match that of physical technology development. This is about diversifying the skill in the marine science workforce, not replacing traditional maritime skills and training, but rather augmenting or adding to the toolbox and empowering people to have the skills to perform both.

With the standards for training and skills in marine autonomy still emerging, those seeking to pursue a career in this field will find it a challenging environment to navigate. There has been significant progress in this area in recent times. For example, the NOC recently signed an MoU with SeaBot XR and the Royal Navy to create a National Centre of Excellence for Marine Operations that will deliver apprenticeships and the skills required for the operation of MAS. It is also encouraging to see universities such as the University of Plymouth offering professional qualifications that include an MSc in Autonomous Systems.

Whilst this demonstrates that we are heading in the right direction, there is work to be done. In conjunction with the regulatory landscape, the development of marine autonomy skills must come from the equipment operators working with the educators at all levels, including schools, further education, higher education and occupational trainers. Organisations such as the NOC, who already have the relevant infrastructure and skills in marine autonomy, also have a leading role in this collaborative effort to develop the UK national capability for autonomous equipment and training. Stakeholders will need to recognise that we will have to build confidence in the technology to loosen the rein on the regulations as we develop and test the technology, as we don't have the years of time-tested knowledge and study as we do with traditional marine operations.

RESKILLING FOR A NET-ZERO ECONOMY

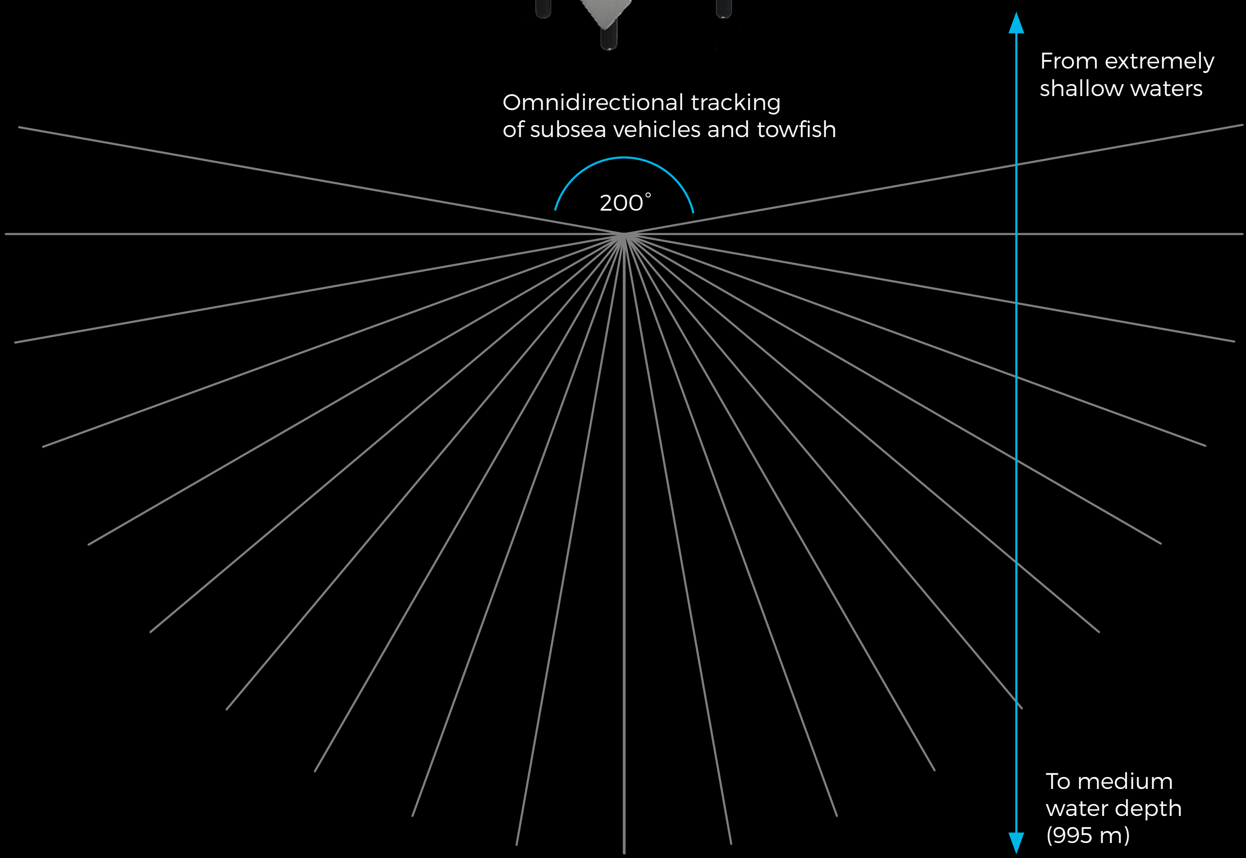
It is also essential to look at the reskilling of the marine workforce in the context of working towards a net-zero economy. Whilst MAS is not entirely free of carbon emissions, it will provide a significant reduction in both carbon and costs bringing both environmental and economic benefits. For example, there is an ambition to map the global seabed by 2030. Undertaking this project using conventional surveying methods would cost over £6 billion and result in 6 million tonnes of carbon emissions. The same survey done with MAS would cost just £1 billion and result in 0.5 million tonnes of carbon.

Marine autonomy is broader than just technology that reduces our dependence on support ships, it is about how the global marine industry transitions to the new world in a safe and consistent manner. And combining the specific autonomy qualifications and skill set in a standardised way is going to be of great significance.

A2KUI having a swim around Loch Ness as part of the Oceanids Programme Trials (Courtesy of NOC)

Never lose track of your AUV.

NEW GAPS M5 USBL SYSTEM
Gaps M5 offers an export-free, pre-calibrated positioning and communication solution for the tracking of subsea vehicles and towfish. Its telemetry feature allows for AUV control & command, INS recalibration, as well as efficient data retrieval.



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