MARINE TECHNOLOGY REPORTER

September 2017

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Voices

Marty Klein

Volume 60 Number 7

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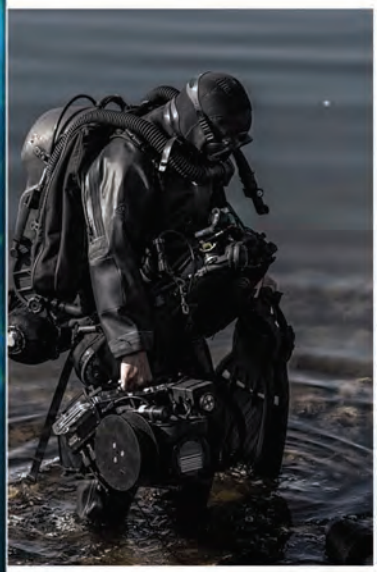

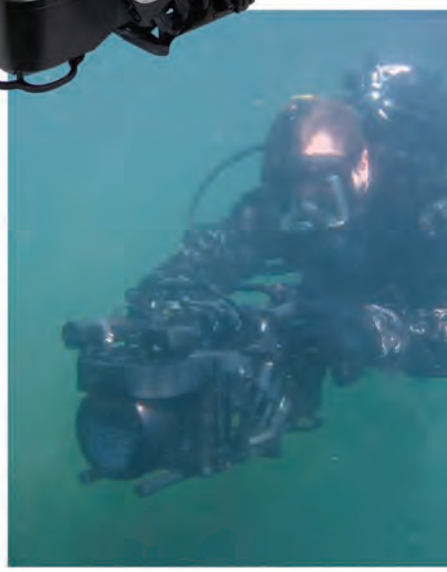

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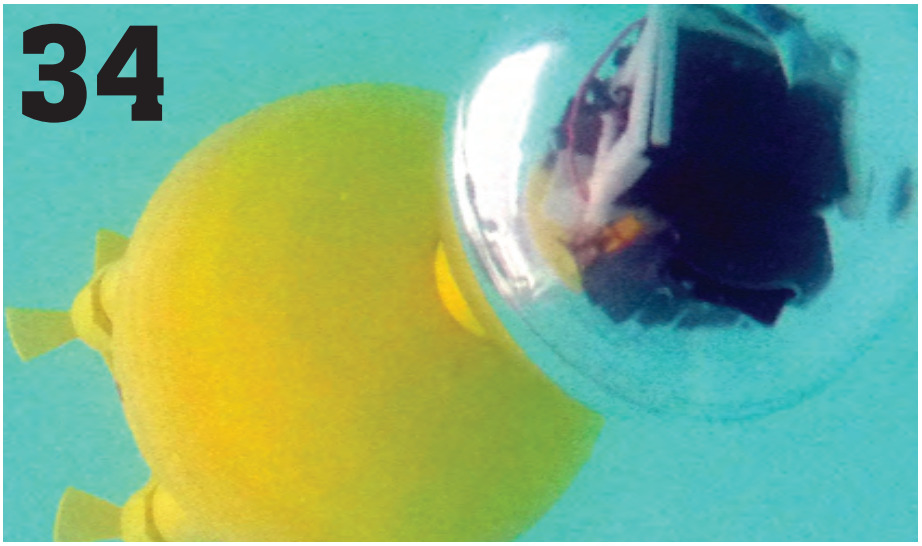
Photo courtesy Paul Kronfeld and Martin Klein / MIT Museum, from the Martin Klein Collection



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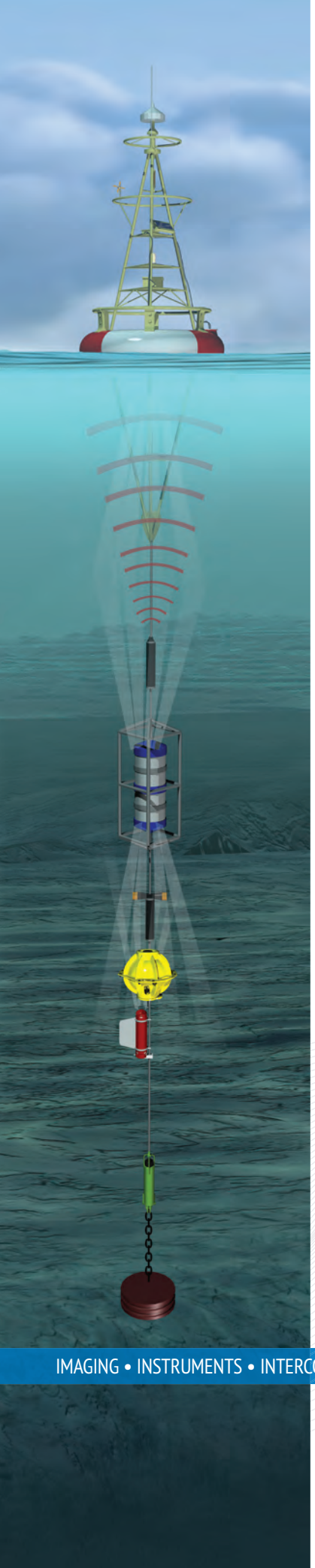

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Editorial

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Above all else I enjoy talking to the pioneers of this subsea industry, the people that literally started in a garage and built something that had never been built before, or made a dramatic technical leap to an existing system. While we cover the quantum leaps in subsea technology everyday online at MarineTechnologyNews.com and in each edition of *MTR*, it is amazing to speak with pioneers from the '60s and '70s, understanding the changes they made, the technology they created, before the PC and the Internet existed. **Marty Klein** is one of those pioneers, and this month we are pleased to present an interesting double feature on the man and the company he founded, both authored by **Eric Haun**. Starting on page 16 we visit with Marty Klein, and as side the photo of an early side scan sonar at the Ixtoc oil field blowout is priceless. (Thanks, too to the MIT Museum which supplied an incredible array of images to us from the Martin Klein Collection). The father of side scan sonar not only takes a nostalgic look at his life and career, but also weighs in on some of technologies of the future. Following the interview with Marty Klein we visit with **Frank Cobis**, the current leader of the company Klein founded, Klein Marine Systems. It is an interesting time for the well-known company and brand, acquired by Mitcham Industires in 2016, a move that has allowed it to refocus the core values of the business to the same values that Marty had when he started the company 50 years ago. The story starts on page 24.

Rounding out our ocean observation coverage is another insightful feature from **Kira Coley** entitled 'Smarter Ocean Robotics' starting on page 30. The story is centered on an interview with **Dylan Jones**, a PhD researcher at Oregon State University, who discusses his efforts in progressing artificial intelligence for underwater robotics, a new algorithm that could lead to 'smarter' vessels.

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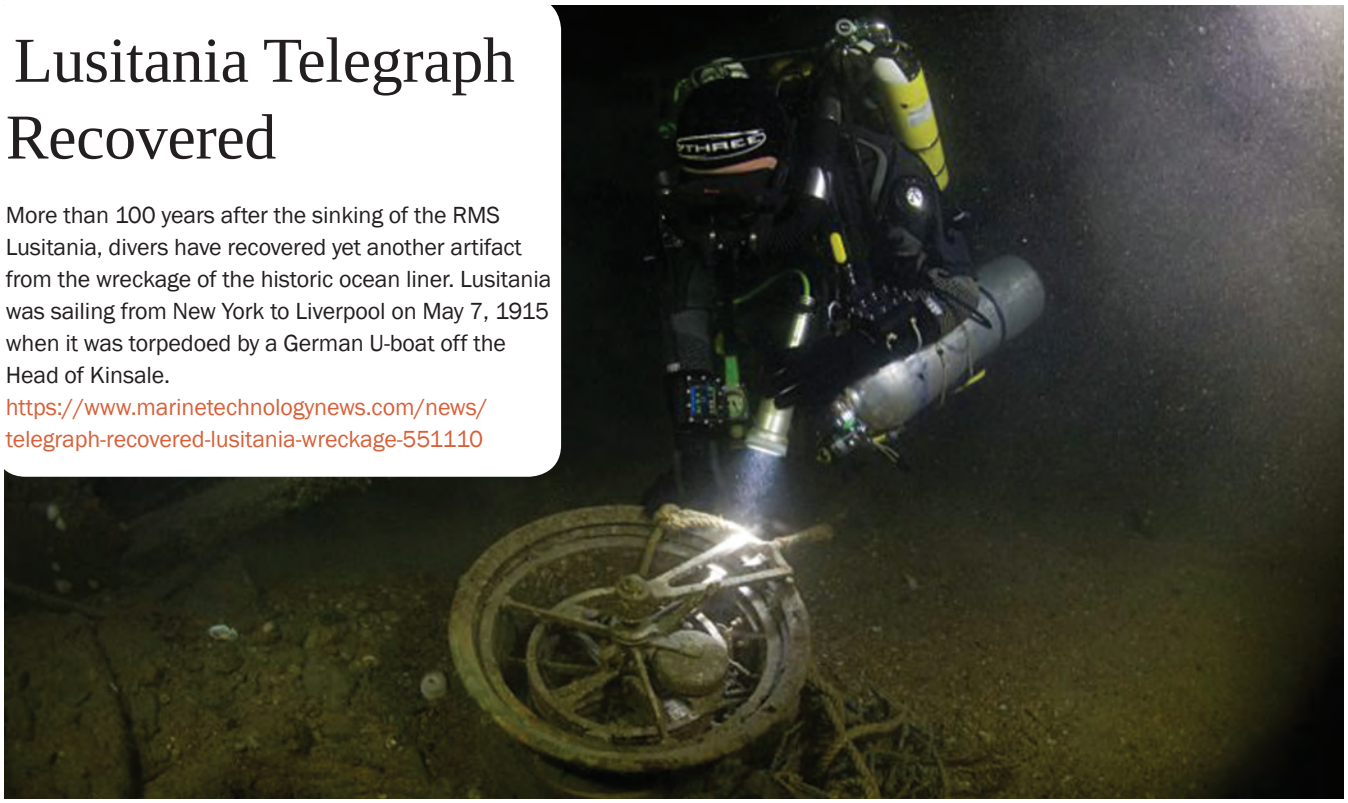
Lusitania Telegraph Recovered

More than 100 years after the sinking of the RMS Lusitania, divers have recovered yet another artifact from the wreckage of the historic ocean liner. Lusitania was sailing from New York to Liverpool on May 7, 1915 when it was torpedoed by a German U-boat off the Head of Kinsale.
https://www.marinetechnologynews.com/news/telegraph-recovered-lusitania-wreckage-551110



(Photo: Ireland Department of Culture, Heritage and the Gaeltacht

Sea Sponge Could Help Battle Cancer

Fisheries and biomedical researchers collaborate to find out if cancer cures are living on Alaska's seafloor
https://www.marinetechnology-news.com/news/sponge-could-battle-cancer-550911

Image: NOAA Fisheries

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RoboSub Competition: 20 Years of Fun and Learning

More than 300 engineering students tested their mechanical, electrical, computer and systems engineering skills, as well as their presentation skills and teamwork, while competing for cash prizes at the recent 20th International RoboSub Competition.
https://www.marinetechnologynews.com/news/robosub-competition-years-learning-551385

Photo: AUVSIF

Canada to Ships: *"Slow Down"*

Certain ships are being ordered to reduce speed because of the deaths of at least 10 North Atlantic right whales in Canada's Gulf of St Lawrence in just two months. The ministries of transport and fisheries issued a temporary order for vessels 20 meters or longer to slow to a maximum of 10 knots in the western portion of the Gulf, which stretches from Quebec to north of Prince Edward Island.
https://www.marinetechnologynews.com/news/canada-orders-ships-reduce-551361

(Photo: Jolinne Surrette / Fisheries and Oceans Canada)

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GEO Week 2017

Discussing how earth observations help the world

Earth observations touch our lives every day, from your morning coffee to your drive home from work. When you're skiing in January or enjoying the beach in July. Whether you're a trader on Wall Street or a farmer in Ethiopia. Open Earth observations support decisions that keep people and ecosystems healthy. They help communities manage their resources and plan for or recover from disasters. U.S. industry sectors, including the maritime, weather, agriculture, re/insurance and logistics have benefited from tools that are derived from free and open earth observation data; promoting and expanding its availability worldwide will contribute to their growth.

The value of earth observations is limited if they are not made accessible to a wide audience so they can be used or shared to support analysis and decision making. The Group on Earth Observations (GEO) operates on the premise that "countries have borders, earth observations don't", and works to unlock the power of earth observations by facilitating their accessibility and application to global decision-making within and across many different domains.

"Open data not only maximizes tax payers' money in government infrastructure, it promotes economic growth, education and capacity building," said GEO Secretariat Director, Barbara Ryan. "GEO wants to bring all sides of the conversation together so that data is broadly and openly available, free to the user and can be used to create value-added products and services to benefit society."

For more than 12 years, GEO has been driving the interoperability of over 400 million data and information resource from space-based, airborne and in situ earth observations around the world. GEO is a unique global network connecting government institutions, academic and research institutions, data providers, businesses, engineers, scientists and experts to create innovative solutions to global challenges at a time of exponential data growth, human development and climate change that transcend national and disciplinary boundaries. The unprecedented global collaboration of experts helps identify gaps and reduce duplication in the areas of sustainable development and sound environmental management.

This October, the U.S. will host GEO Week 2017 in Washington, DC. GEO Week, consisting of the GEO-XIV Plenary, side events, and exhibition, will highlight and promote the role, applications and opportunities to use earth observations (EO) in delivering 'Insight for a Changing World'. With a focus on delivery and impact, GEO Week 2017 will explore the use and application of Earth observations in both the public and private sectors for the benefit of humankind.

This will be an important opportunity to highlight U.S. leadership in earth observations, and GEO Week 2017 will find the greatest success through the engagement of industry partners (large and small), organizations and government agencies that make earth observations work in this country and other parts of the world.

More information on the event can be found at
www.earthobservations.org/geoweek2017

GEO Week 2017

What..... GEO Week 2017
When.....October 23-27, 2017
Who.....Group on Earth Observations (GEO)
Where.....Ronald Reagan Center, Washington, D.C.
Web..... www.earthobservations.org/geoweek2017

The Photo

One of the fascinating aspects of viewing Earth at night is how well the lights show the distribution of people. In this view of Egypt, we see a population almost completely concentrated along the Nile Valley, just a small percentage of the country's land area.

Image Credit: NASA:Historic Images on Flickr Commons

Photo: ESRI

Digital Transformation of Port Operations

By Guy T. Noll, Maritime Principal Consultant, Esri

Electronic Navigational Chart (ENC) data, also known as S-57 data, provides a great beginning for a national marine spatial data infrastructure (MSDI). Unfortunately, in much of the world outside the United States, national hydrographic office licensing restrictions on ENC data—implemented to ensure quality of navigation information for safety of life at sea (SOLAS) compliance—limit the official use of S-57 data for non-navigational purposes. In an analogous limitation, many ports—where the economic levers of maritime advantage for a region or nation are fulfilled—do not perform the requisite data management that leads to the explicit assessment of risks to their underwater infrastructure. However, the National Oceanic and Atmospheric Administration (NOAA) has been exceptional in its open data policy for S-57, and this has led to broad innovation in the use of ENC data in both navigation applications and non-navigational engineering and biological analysis.

Every port has depth information. After all, that's what differentiates a port from the non-port land around it; personnel know how deep a ship's draft can be for cargo transfer. This information needs to get to the mariner and be sent upstream, respectively, to the cargo shipper; to the cargo contract holder; to the insurance agency; and, finally, to the reinsurer. Currently, the primary mode of delivery of that information to all parties is the ENC for commercial shipping. National hydrographic offices, such as NOAA's Office of Coast Survey, compile these information products and disseminate them by a variety of means. This ensures that the information meets certain requirements and can be legally substantiated. A significant amount of expertise and manpower is required to conflate and compile the data into these cartographic products, and making them has traditionally been a multimonth or, sometimes, multiyear effort. This degrades the value, however, because by the time the end product ENC is in use by the supply chain, the actual depth along the transit can change from what was reported to the mariner, the shipper and the insurer.

NOAA has moved to a vector-first production cycle to improve the velocity of the information product supply chain, and feedback on the NOAA National Charting Plan raised eyebrows when the option of eliminating printed charts was brought up. There are now weekly releases of ENC updates, and NOAA is investigating a user-driven area-of-interest

ENC data layered with imagery that illustrates actual structure and use.

printing system that uses the same information stream. Usability could be improved by increasing the velocity of data from the ports. But what if a port could provide responsible data that has reliable metadata for inclusion in NOAA's compilation system? Taking this a step further, what if there were a local copy of the compilation system that the port could maintain and periodically check in to the NOAA system? Extending this pattern to computing clouds, an authoritative and role-based access subscription in a Federal Risk and Authorization Management Program (FedRAMP)-certified system would allow ports to easily participate in a national system that provides the best access to the most recent navigation information.

These assessments should be made using maintenance procedures that include the following: surveys performed prior to and after dredging to determine payment and identification of dredging periodicity requirements, accurate surveys of berthing areas for loading at lower stages of tide and determination of the threshold clearance depth in a common area for access to a port from the main entrance. If only performed as baselines or snapshots—and not surveyed with ample coverage or enough frequency to enable staff to understand change over time—port operations assume a time-varying risk relative to a variety of factors, including water levels, sedimentation rates, sea states and vessel draft.

Reducing navigational risk by taking a more active role in underkeel clearance management is a goal of a prototype project undertaken by the Port of Los Angeles and NOAA's Office of Coast Survey. In this project, live measurements of the ocean swell at the port's entrance, combined with high-resolution bathymetric surveys, have helped define allowable ship drafts for the port and the pilots at sea and provided decision support guidance to reduce risk of grounding. Taking this prototype project to a national scale would require more instrumentation and a framework of activities that would overwhelm smaller ports' limited staff. However, there may be a way to leverage what has been learned in the Port of Los Angeles and apply that knowledge through a computing cloud-based data pattern, resulting in getting navigational information to the mariner in a more timely manner. For many U.S. ports, this information could be added to the NOAA Physical Oceanographic Real-Time System (PORTS) observation network.

Such a system would give the port control over how often and to what extent the information reaching the supply chain

Continued on page 15

Photo: ESRI

ENC portrayal of dock without imagery—note the lack of mooring "dolphins."

would be updated. This then would afford a competitive advantage to the port's operational infrastructure. Simultaneously, it would increase the value of the MSDI that NOAA contributes to the national Blue Economy along with the river infrastructure maintained by the U.S. Army Corps of Engineers, the highway infrastructure maintained by state departments of transportation and the aviation infrastructure maintained by the Federal Aviation Administration and airports.

A centralized geographic information system (GIS) can share compiled ENC information while maintaining the security of underlying data, thus ensuring that vector information can be used for nonnavigational purposes and not in chart compilation. GIS allows the authoritative output of the hydrographic office to be shared with key stakeholders, whether those are national agencies responsible for safe navigation, regional authorities in charge of marine spatial planning or ports managing underkeel clearance risk. The Information for Maritime Infrastructure (IMI) of ports, including the myriad silos of vessels' real-time information, meteorological conditions, water levels and shoreside assets, should all be brought together into a unified common operating picture (COP) for situational awareness. Also, this COP should be viewable by any authorized users—from anywhere, at any time, on any device—according to their role in the operational shipping activity. A flexible software platform with open data architecture and a holistic GIS can provide such a picture.

A port may have a few surveys from past dredging projects—maybe from pier reconstructions—in formats such as comma-separated variable (CSV) text, spreadsheets, ASCII XYZ, AutoCAD or Terramodel format. As foundational datasets, these surveys need some descriptive text—such as the date of data acquisition, who did the surveying and what kinds of instrument and positioning were used—to become informative and retain value over time. Of course, vertical and horizontal reference points for the data are needed, too. If these points are all converted to a point cloud of XYZ and a grid is created from that cloud, when this data is combined with the attributed metadata, the result is a bathymetric surface that has attributes at each grid.

Photo courtesy Paul Kronfeld and Martin Klein / MIT Museum, from the Martin Klein Collection

Klein Side Scan Sonar was used to map the ocean floor near the Ixtoc oil field blowout.

The company known today as Klein Marine Systems, Inc. has origins stretching back to the 1960s when Marty Klein, who many consider to be the father of side scan sonar, began building his own devices from his home in Lexington, Mass. As this iconic subsea technology company approaches 50, MTR speaks with Marty Klein as well as Klein Marine System's general manager, Frank Cobis.

By Eric Haun

Klein

When did you realize you were destined for a career in the subsea world?

Wow. It started back in 1961 when I was a senior at MIT and I had to do a thesis. I like to build things, but I seemed destined to work on some very theoretical project. I knew of Harold Edgerton, the famous professor, and I went into his lab and asked if he had anything interesting that I might work on. He introduced me to his world and partly to the ocean world, and I think I was hooked right from the beginning.

What kind of projects was [Edgerton] working on at the time?

Edgerton was famous for the development of strobe light – he's known as "Papa Flash" – but back in the late '50s he was introduced to Jacques Cousteau by the National Geographic Society. Cousteau wanted to take pictures in the deepest part of the ocean. Edgerton wound up making him a deepwater camera and strobe light, and together they took the first pictures in the deep ocean. Edgerton's device used a precision timed pinger that helped him to get these first deepwater pictures. Edgerton noticed that his pinger was penetrating the bottom of the seafloor a little bit. He began a fascination himself with underwater things – underwater cameras, strobes, sonar, boomers and other devices – and was working on a device he called a "mud penetrator". It was just a converted navy echosounder that he was pulsing to look through the sediment of the Charles River in Boston and Boston Harbor, and sort of by coincidence I came onto this scene.

As a teenager I had been an electronics hobbyist. I had some experience working on these new devices called transistors, and I was able to improve the signals on Edgerton's devices. At some point Edgerton turned his pinger, and instead of pointing it down he pointed it sideways and he made kind of a crude side scan sonar. I was working with him – first I worked in his lab and then he had had a company Edgerton, Germeshausen and Grier, which later became EG&G, Inc. The Oceanographic Department at E.G.& G. evolved and nowadays it has transformed into EdgeTech. And this sonar did pick up things on the seabed, but it made very crude pictures. We used the technology when the submarine Thresher sank in April of 1963, searching from the Bathyscaph Trieste. We worked very hard on that sonar device, and to make a long story short, it failed. The resolution was not good, and it had some other problems. So I was determined to make a real side scan sonar that would make pictures so that a shipwreck looked like a shipwreck and airplane looked like an airplane and a pipeline looked like a pipeline. I was obsessed with making that happen.

How did you take the crude sonar and turn it into something more useful?

Some of the technology existed in various places, [such as] in the military and in research institutions. But the idea was to go to a much higher frequency and to go to a very different beam shape. Whereas the original device was just used in a 30 degree cone shape and a low frequency of 12 kilocycles, as we called them in those days, I went to high frequencies. The first one I built was 260 kilohertz, with a beam that was narrow in the horizontal plane and wide in the vertical plane. And also beams that look out to both sides of the ship rather than just pointing in one direction. So it involves going to higher frequency using a very short pulse length and using a specially shaped beam in a towed vehicle that was towed near the seafloor to make much better pictures.

From there, what was your vision?

I made the side scan sonar at EG&G and introduced it to the world 50 years ago at a Marine Technology Society meeting in San Diego. EG&G started making a product that was very successful. There were some problems working at a big company. I never quite received the support that I wanted . . . and I had ideas to make better equipment, to improve it, to make other kinds of equipment, and I took the lead. I had no background at all in business, no education in business. I took a tremendous leap and started my little business when I was living in a tiny rented home in Lexington, Mass., and I literally started my company in the basement of this little home. In 1969 I moved the company to an old lumberyard in Salem, N.H. where there was room to expand. The rest is history. They are still there. Although I've been gone for a long time, the company is still there and they're doing really good things. The company is now called Klein Marine Systems, Inc., a division of Mitcham Industries.

What were some of the earlier projects you were involved in when you started your company?

The projects involved both equipment and expeditions. I went on all sorts of expeditions, both before and after I started

Photos (L to R):
Humble Beginnings-Klein Associates began in the basement of a little rented cottage in Lexington, Massachusetts.

A page from Martin Klein's Laboratory Notebook noting the founding of Klein Associates.

Marty Klein at his desk at Klein Associates.

Martin Klein with a Klein multibeam side scan sonar. "We were proud that side scan was able to finally replace the old wire drag technology."

Photos courtesy Martin Klein and the MIT Museum

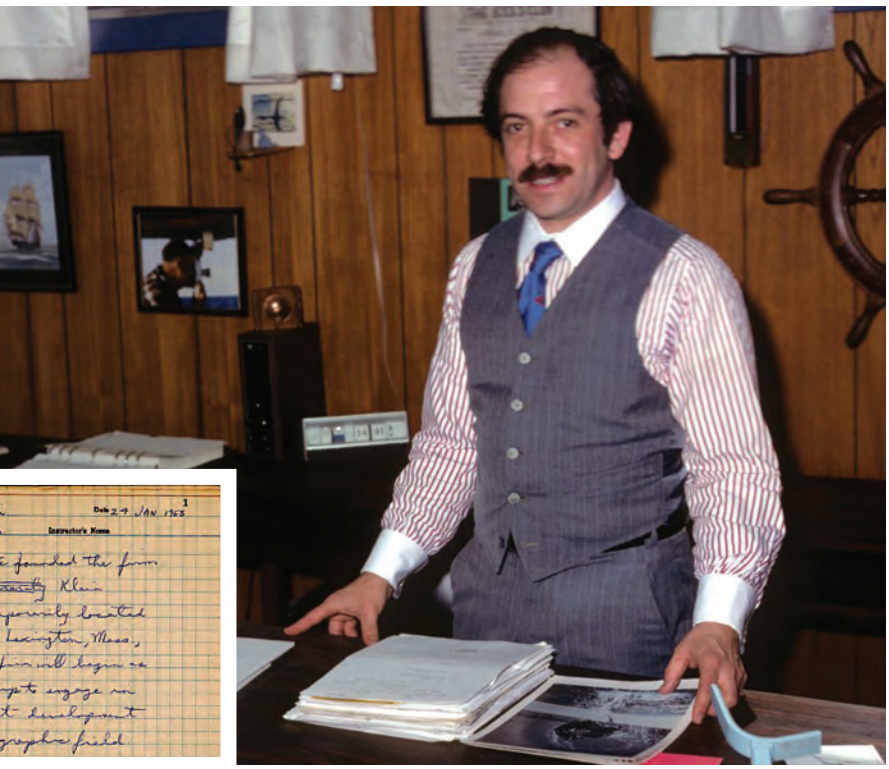
the company. A lot of them I didn't go; my customers went. All kinds of shipwrecks were found, for example the Hamilton and Scourge, the War of 1812 ships in Lake Ontario; the space shuttle Challenger; a lot of airplane wrecks were found. One of our biggest projects: I went Loch Ness a number of times and had some interesting projects there. Among other things, I found a Wellington bomber from World War II that was since raised and put in a museum in Brooklands in England. We were involved with Bob Ballard in the search for Titanic. We were involved with the search for the Edinburgh that held gold bars from Russia. We were involved with the De Braak. We were involved with the Atocha, the famous treasure ship.

In the last 50 years surely a lot has changed in marine technology. What are some of the most important technological advancements at your company and for your products in particular?

There have been many changes over the years. In some ways the basic sonar – the basic technique – is not that different than it was years ago. There are fancier versions being made. One of the things we did over the years is make ones with dual frequency. We combined the side scan sonar with a sub-bottom profiler and also a device we called the micro profiler that could get the tops of little pipelines on the seabed. We patented a scheme to combine a side scan and sub-botton profiler with a magenetometer. But one of the biggest changes is the change to digital. The old machines used to use a mechanical graphic recorder with analog signal processing. It worked, but it had all sorts of problems, it was expensive to make, it was difficult to operate. And the transition progressed where the machines went from those mechanical recorders to thermal graphic recorders and eventually to computer displays. The display used to be on a color television, but nowadays you can put it on a laptop so you don't have this big clunky mechanical recorder and you can easily record the data digitally so you can go back replay it and do other processing.

Another huge change is the area of navigation. Navigation has changed drastically since I started. When I started in the field we used to position the ship with transits, theodolights and hand-bearing compasses. I was involved in some of the first electronic positioning systems. I participated in a survey of the English Channel back 1964 where we used something called Decca HiFix to navigate the ship electronically. But then eventually global positioning came along so for very little money you can get a very precise navigation system, put it on a ship, and you can get the navigation data and combine it onto the sonar records. You can record, you can do survey lines, you can have the recorder plot the survey lines, where have you been, you can go back to a spot if you found something. So there's huge changes in the use of combination of computers and navigation with the side scan.

There has also been a lot of work on the image processing. You improve the sonar data to expand and enhance the data, and also make the equipment easier to operate.



Photos (L to R):
Black frame images: Martin Klein holding an EG&G Side Scan Sonar Towfish.

Inset: Martin Klein with Side Scan Sonar MK-300.

Famed author Clive Cussler with marine archaeologist Sydney Wygnall using a Klein Side Scan Sonar during the search for John Paul Jones ship Bon Homme Richard off the coast of Bridlington, England

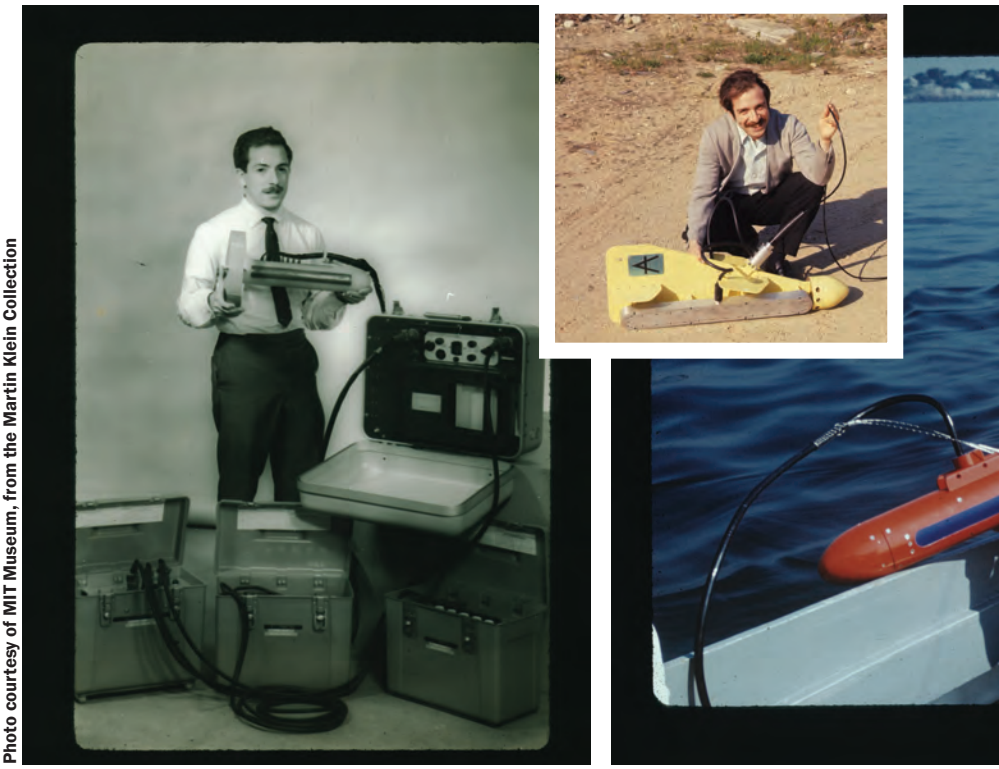


Photo courtesy of MIT Museum, from the Martin Klein Collection

Outside of your own technology, what one technology do you believe has had the greatest impact on allowing humans to study the oceans?

Whoa. It's such a broad subject and I was involved with so many, and I feel proud that my own devices helped to open up the world of the ocean. We use the term 'Make the Ocean Transparent.' I think we made a difference. Nowadays many devices use our technology - the underwater vehicles – the human occupied submersibles and then the remote operated vehicles – and now there's a transition going on to autonomous vehicles that you can send out without humans in them that have all sorts of advantages.

I've been involved for many years with Sea Grant. The Sea Grant program is also 50 years old this year. And I've been involved with it in various ways since it began in 1967, especially at MIT and the University of New Hampshire. A lot of the autonomous vehicle technology was developed at MIT. The company Bluefin [Robotics] got its start as spinoff from MIT Sea Grant, and so I think that is making a big difference in our abilities to do ocean exploration.

Are there any technologies in development now that you're keeping an eye on or see as particularly exciting?

I keep an eye out all the time. I'm retired, but I'm still fascinated by the ocean, the subject of exploring the ocean. The equipment we have, although I'm very proud of it and proud to have gotten a lot of things started. If you look at a magazine like yours, it seems every few pages there's a side scan sonar image of a ship wreck or picture of something on the bottom. I'm proud of it, but I feel like there's going to be breakthroughs where we can have more coverage, have better pictures, have pictures that you can take at high speed and that look more like aerial photographs and so I'm still waiting for breakthroughs in technology.

I'm involved in a lot of things where students are involved. I just came back from the MATE Program. I'm involved with the MATE ROV competition. We just had an international competition in Long Beach, Calif. The students come from all over the world, and they're working on these vehicles – these underwater vehicles – I always have my eye out for kids who might be the next Jacques Cousteau or Bob Ballard or Ed Link or George Bass or Elisha Linder. I still think there are breakthroughs to be made that will improve this technology dramatically.

What do you consider to be your biggest success?

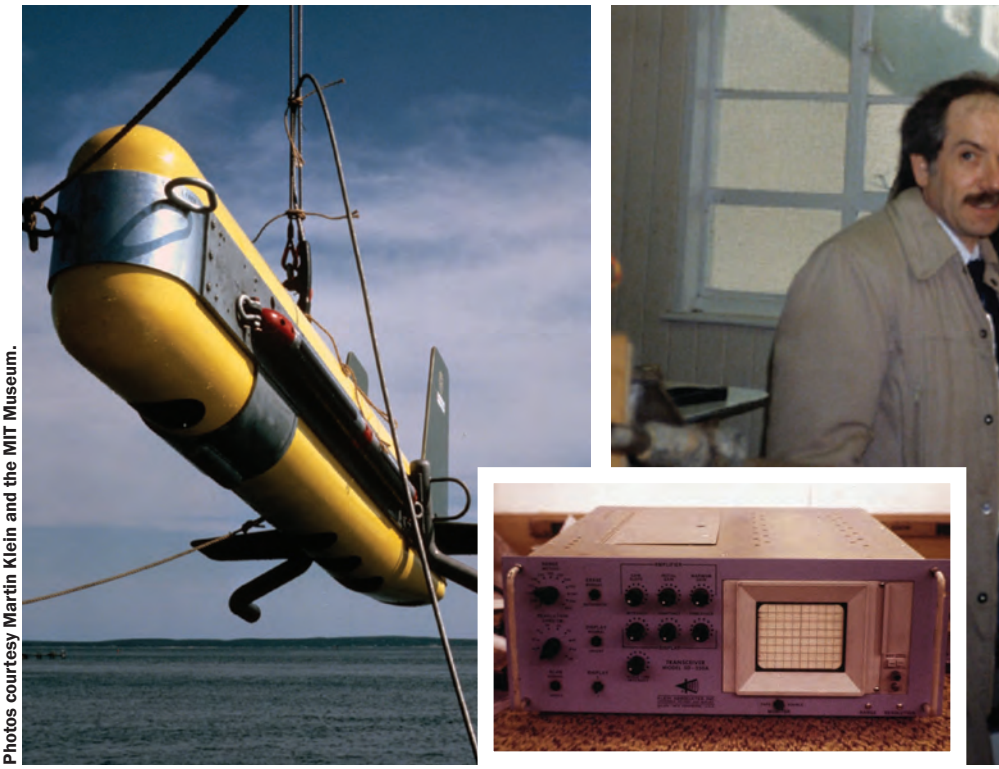
In the ocean field: I did not invent side scan sonar. People often say that my old professor Edgerton invented side scan

Photos (L to R):
The Klein SMARTFISH combined side scan sonar-sub-bottom profiler. Capable of operation at full ocean depth.

Inset: One of the first devices able to produce a side scan sonar record on a cathode-ray-tube screen.

Marty Klein with a section of the Wellington Bomber that he helped to find in Loch Ness in 1976.

Marty Klein today.



Photos courtesy Martin Klein and the MIT Museum.

One of the biggest changes is the change to digital. The old machines used to use a mechanical graphic recorder with analog signal processing. It worked, but it had all sorts of problems, it was expensive to make, it was difficult to operate.

sonar or I invented side scan sonar. He did not, and I did not. But what I did was introduce to the world 50 years ago a commercial version that was affordable, that was rugged, that was reliable, that produced good results. And I really feel proud that it did change the world of ocean exploration.

In your career, what was the biggest challenge you faced, and how did you overcome it?

There were so many. Working in the ocean isn't easy! People often take it for granted, but making high technology equipment that works in the ocean, that can run 24 hours a day, and work in boats and remote parts of the world, and work in very deep water is very challenging. There are many challenges with electronics, with circuitry, with mechanical things, with cables, with connectors, with transducers, with encapsulation, and so many, many challenges. Still to this day, you don't go to the library and pick up a book on how to build a sonar. There's no such thing. So we had to develop a lot of these technologies. I certainly didn't do it on my own. I had a lot of help. A lot of things, you can go to the library and get a book on how to make a garden – whatever – how to cook a meal. But there's still a lot of technology to learn and develop, and a lot of it is still challenging.

I still love this field. I'm still very excited about it. I appreciated what folks like you do: keeping people informed about what's new. It's still a relatively specialized field, and to some extent it's a small family, and so I feel very excited about it. I still feel that there's tremendous potential to create, and find things of cultural importance, finding ancient things, finding bottom geology, finding things that create jobs, improving the environment, improving our abilities to look at sea life, to find fish and to study them and other environmental aspects. I still really like the field. So many fields are very mature, and I still feel in many ways work in the ocean is in its infancy. There's stuff to be found, and I feel honored to be a part of that.

Frank Cobis

Frank Cobis has had a long and vibrant career in the subsea technology industry. Today he leads Klein Marine Systems as vice president and general manager. Here he delivers an update on the company, its offering and the technologies driving change..

By Eric Haun

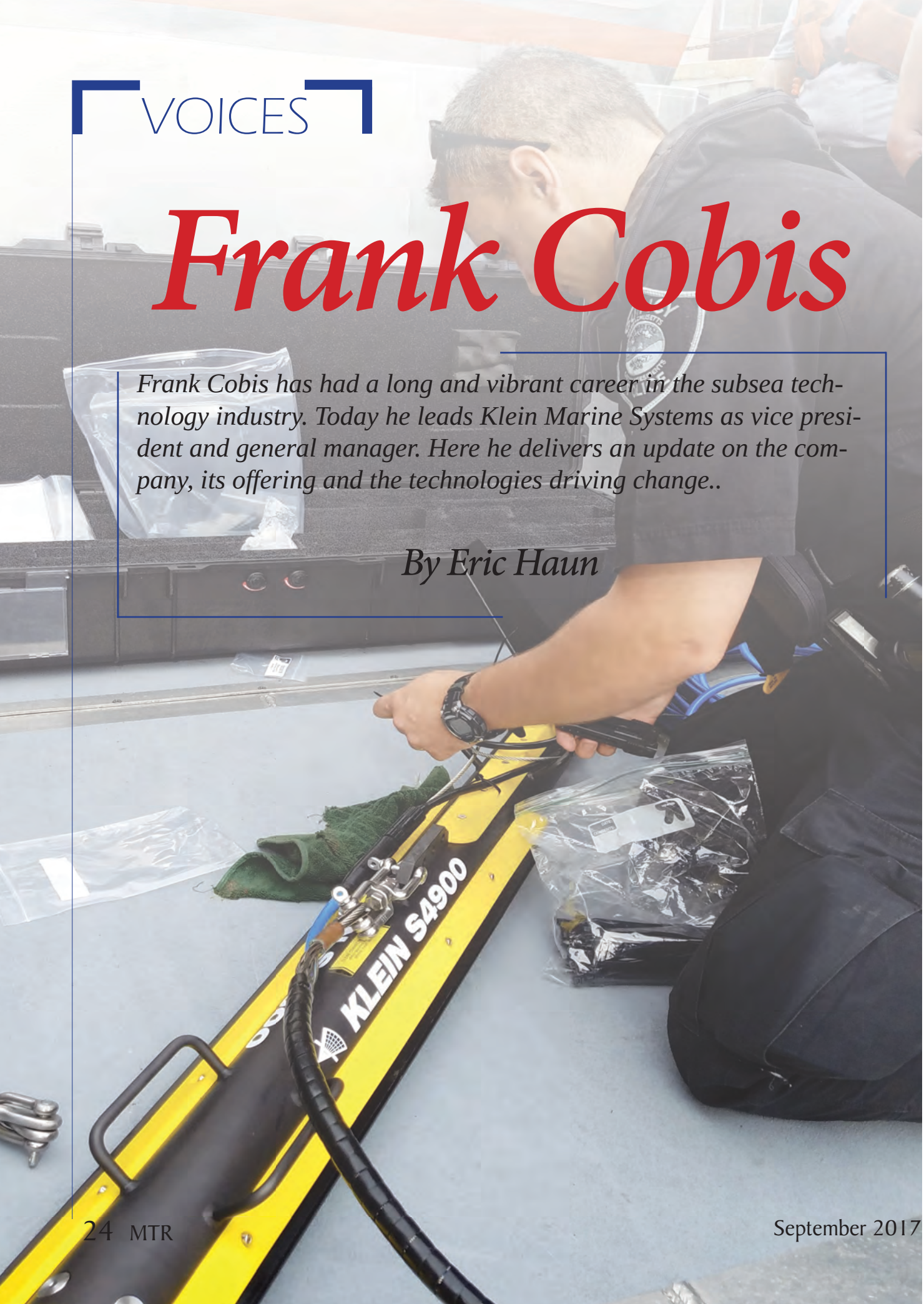


Photo: Klein Marine Systems

Please tell me a bit about yourself, your career and how you came to Klein Marine Systems?

I've been in the marine technology industry basically my entire career; more than 30 years. I started in the early '80s with a company that manufactures deep-water multibeam sonar systems, SeaBeam Instruments. I worked for SeaBeam through the early 2000s under several different ownerships. In this timeframe, both SeaBeam and Klein were acquired by L-3 Communications, and the two companies were merged based on their complementary technology and close proximity – we're in New Hampshire and SeaBeam was in Massachusetts. So, officially I joined Klein in 2004 as the vice president of programs.

What is the size and scope to Klein Marine Systems today?

Klein was acquired by Mitcham Industries January 1, 2016. Mitcham is a small, nimble, international company with deep commercial roots in the marine technology industry, and it was a welcome acquisition on the part of Klein as it allowed us to get back to our core values and refocus on the commercial side of the business. At that point in time, we also reengaged with Marty Klein, and we consider Marty to be an ambassador for our company.

What's changed since January 2016?

Like I said, the new ownership has allowed us to refocus

New ownership has allowed us to refocus on the core values of our business. These core values are the same values that Marty had when he started the business. It was all about delivering a high performance product, quality and providing excellent customer support. Our tagline, as you might have seen, is, "The difference is in the image," and for us that resonates in everything we do. We're not satisfied with our product performance until we have a side scan image that looks photographic.

Frank Cobis, VP & GM, Klein Marine Systems

on the core values of our business. These core values are the same values that Marty had when he started the business. It was all about delivering a high performance product, quality and providing excellent customer support. Our tagline, as you might have seen, is, "The difference is in the image," and for us that resonates in everything we do. We're not satisfied with our product performance until we have a side scan image that looks photographic.

What's changed externally to our business is that the marketplace has become more complex and more competitive. This change has repositioned our product development toward common platforms and more modularity in our system design. This building block approach allows us to be more nimble and allows us to better perform in the current competitive environment.

For example?

We recently released two new single beam products that we're real excited about. The Klein 4900 and 4000 systems are based upon our very successful UUV-3500 sonar engine. Both products use our high performance data acquisition front-end and our new telemetry design. There's modularity in the power interface and transmitter designs which we already have plans to use in our next product currently under development. From a software perspective, we have a single code base that allows us to build multiple versions of software for this family of products.

We can also build custom solutions using these modular components, and that's another piece of the business we find very challenging. We have our standard product line, but we've also developed many custom designs to meet customer specific needs. We look forward to customers bringing their inquiries to us where they have a unique project with challenging requirements where they just can't buy something off the shelf. Our goal is to work closely with these customers to develop custom configurations to satisfy their needs.

What market demands will drive the technology ahead in the next few years?

The market expects continuous improvement. Our customers are constantly requiring us to produce products that provide better area coverage, better resolution and better

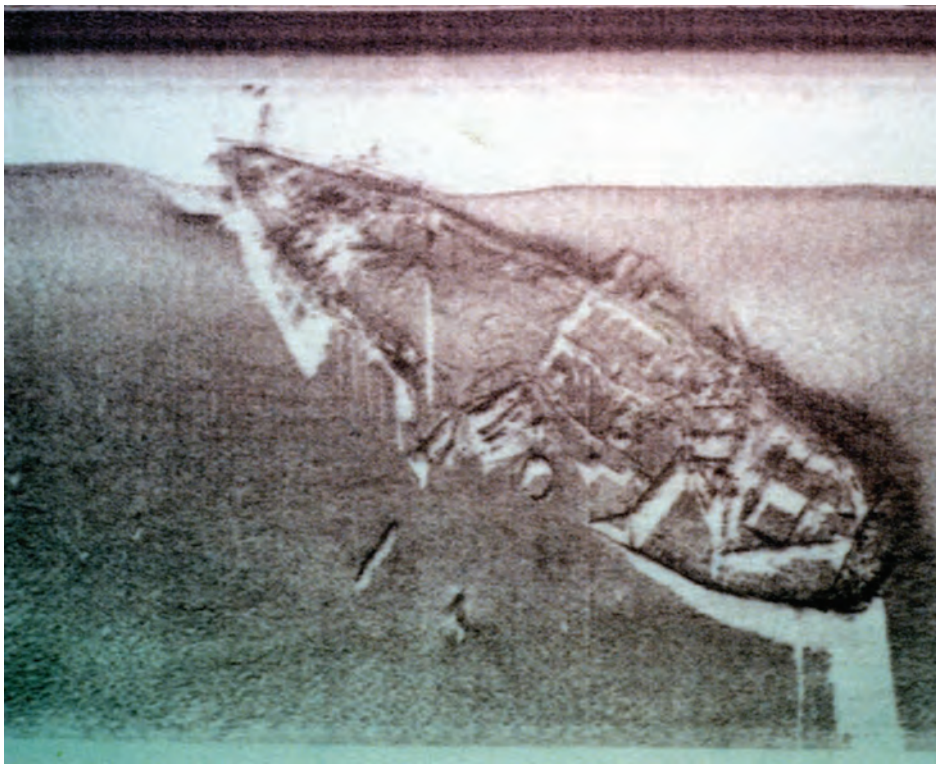
system accuracy. We're constantly taking advantage of technology advances that allow us to provide these kind of performance discriminators. Ease of use is a big thing, especially for entry level products where a customer wants to be able to pull it out of the box and connect the cables, flip the switch and immediately start using the system.

We just recently finished a SMART telemetry design, and I think we're the first in the industry to offer this capability. The tow cable is typically a customer supplied piece of the overall system. You bring a side scan onto a ship, there's already a winch on board, it's got a cable on it. You want to run that sonar with that cable. So with this SMART telemetry design the system measures the electrical parameters of the interconnect between the topside equipment and tow fish – deck cables, slip ring and tow cable – and selects data rate and filter settings that minimize telemetry errors while maximizing data throughput. This results in continuous, high quality imaging over a broad variety of cable types and cable lengths. In the case of standard fixed rate telemetry systems, they simply stop transferring data

Photos (L to R):

That was then, this is now ...

Left:
A Klein 500kHz side scan sonar record of the Vineyard Lightship. Klein produced the first commercial high-resolution side scan sonar and the first dual-frequency side scan sonars.



Photos courtesy Martin Klein and the MIT Museum.

when the cabling will not support their required data rate. This could be caused by excessive length, aged or degraded cable or poor electrical connections. With our SMART telemetry design, if the automated test of the system cabling results in an available data rate lower than that required for the higher bandwidth pulse types of the side scan system, the software readily adapts the user settings to those supported by the available data bandwidth, keeping the system available for use across a broad set of cable configurations. The bottom line is you always come back to shore with data.

We also have several new products under development which will provide game changing performance when released. It's too early to talk about these developments, but we are very focused on bringing them to the market.

You mentioned earlier the focus on producing photo-quality imaging. Will you discuss some of the evolutions that have recently taken place in this area?

Most of our new products are based on broadband technology which allows the image to have a much deeper, richer, tonal quality. Complementing this architecture is a number of signal and display processing improvements which further enhance the imagery.

Where do you see the greatest opportunities for growth?

From our perspective, we recently developed a new high-end sonar, the Klein 5900. We're seeing a lot of potential growth in the military market for this product. We still consider this a commercial system solution, but it fits well within a lot of military MCM applications. The interesting thing about the 5900 system as compared to some of the full-up true military systems is you can get 90 percent of the performance for less than 30 percent of the cost. So there's a value proposition there and we're finding that there are a lot of military customers that are very interested in this system and its performance.

Another area of growth is the vehicle market: ROVs, AUVs, USVs and special purpose platforms. This market is growing in leaps and bounds, and in this market our products are more a sensor payload than a system. These payloads need to be tightly integrated into the vehicle to achieve the desired performance. This is an area we're really focused on because it's a bit different; again, you're a sensor versus a system. So you have to work very closely with the system integrator – typically the vehicle manufacturer – giving close attention to power, cooling, electrical/mechanical/acoustic interference and the software interface to insure optimal performance. This is a growing market and a market that we're paying very, very close attention to.

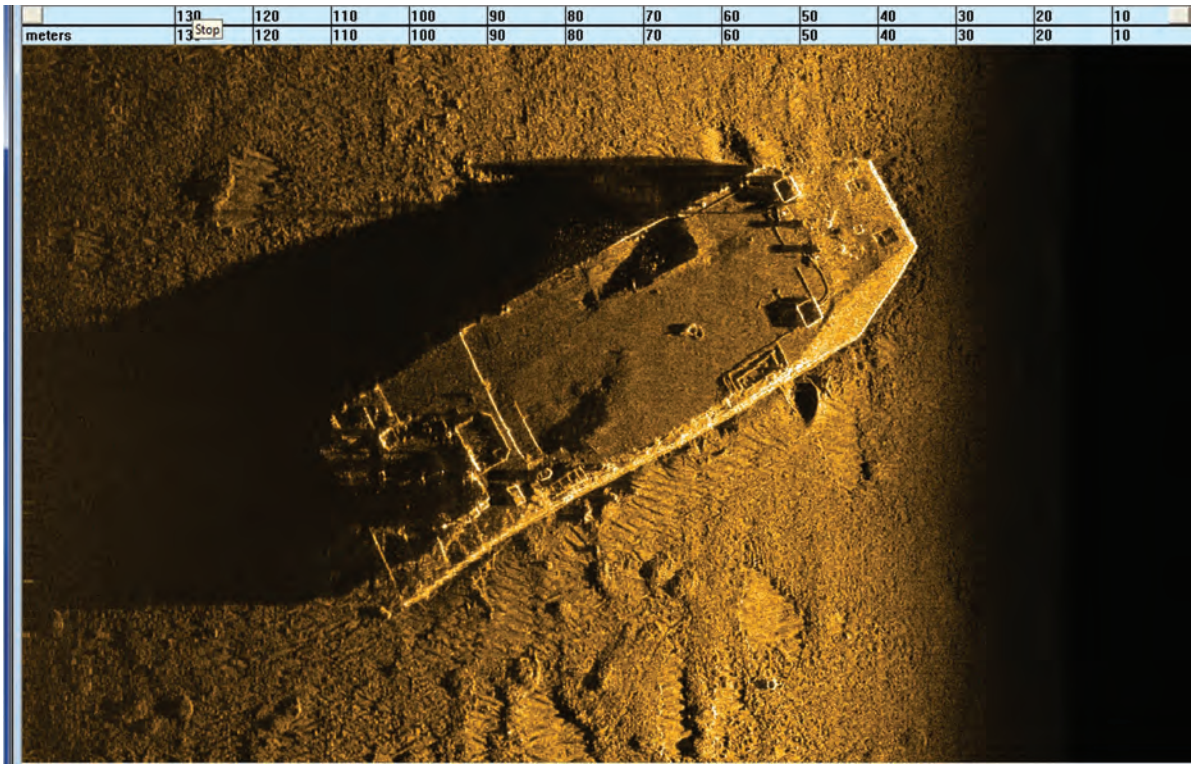


Photo: Klein Marine Systems

Smarter Ocean Robotics

It is evident by now that we are in a robotics revolution. In almost every industry, from healthcare to hospitality, robots are emerging that can successfully complete a task without the human element. Artificial intelligence (AI) is also advancing at phenomenal rates beyond what some imagined possible this decade. The marine sectors have embraced robotics in data collection and exploration, but the infancy of AI in our industry delays progress toward the perfect synergy between humans and machines in the underwater realm.

By Kira Coley

Credit: Dylan Jones

Right: Representative paths planned across the surface of Kirk Lake in Eugene, Ore. The naive paths represent taking a straight path from the start to the goal while replanning and oracle utilize information about the wind.

Autonomous surface vehicle on Kirk Lake in Eugene, Ore., during field trials.

Ocean Observation

The problem is, for robots exploring complex ocean environments, 'smart thinking' is easier said than done, according to Dylan Jones, a PhD researcher at Oregon State University. Jones talks about his efforts in progressing AI for underwater robotics, and the new algorithms that could lead to smarter vessels and more energy efficient missions.

"At the moment operators tell the vehicle to go from point A to B for example, and the robot will go there in a straight line. Today's ocean robots aren't doing anything clever in that sense, and there is still a significant workload for the human to deal with. What we are hoping to do is to make these missions easier so the human can focus on other things," Jones said.

"My research explores how robots can decide the best path to take during a mission without the human. But, as is often the case, the ocean adds another layer of difficulty to this problem. So, more specifically we are exploring how vehicles can make decisions in these complex environments that allow them to perform their missions more efficiently."

Jones and PhD advisor Geoff Hollinger, assistant professor of mechanical engineering in OSU's College of Engineering, have built a framework for underwater vehicles to choose the most energy-efficient routes by considering environmental disturbances, such as ocean currents and surface winds.

Ocean currents can have a massive influence on the efficiency of vehicles and, therefore, the length of time they can stay out in the field. When the algorithms are integrated into vehicles such as AUVs and gliders, they should have the ability to think intelligently, 'what is the most efficient way to get from point A to point B in this environment?' If they can learn to do that, then these vehicles could expand the life of the mission by days, weeks, or perhaps even months.

Smarter Thinking

The framework designed as part of the university's robotic program involves an algorithm that samples alternate paths, as well as comparison metrics that lets a vehicle decide when it makes sense to switch paths based on new information collected about the environment.

"We use forecast data to plan missions, but that means in truth we are just estimating. So, the re-planning element of this research is accounting for that. The robots can determine when the forecast is wrong and adjust their path. For example, based on the forecast data it expects the current to be going south but it is going south east, so the robot can learn as it executes and adapts its plan accordingly. It's similar to what humans do when avoiding traffic on roads – we learn about our environment, and then we adapt," Jones said.

The results, recently published in IEEE Robotics and Automation Letters, show that the algorithm can plan vehicle paths that are more energy efficient than ones planned by existing methods. It's also robust enough to deal with environments for which not much data is available.

Jones's research will also deal with "informative path planning" – planning paths that initially gather information about the environment and disturbances that the algorithm can use later to plan more energy-efficient routes.

"What we want to do is to put these two things together. So, how can we collect the data oceanographers want but still travel efficiently? Is there a way to balance these things to prioritize tasks? And, are there benefits if the robot is less optimal at the start? Let's say you are driving from point A to B. Rather than going straight to point B you decide to check the traffic on the freeway by driving over the overpass. If it is clear, you get on the freeway but if there is traffic you take a different route. So, when it comes to robots, you might start by taking a slightly less optimal route to find out more about the environment. Using that information, you can then plan the most optimal journey for your mission."

But how can engineers combine these two ideas – planning

Photos (L to R):

Left:
Platypus Lutra Prop autonomous surface vehicle. Used for experimental verification of algorithms.

Right:
SeaBotix vLBV300 remotely operated vehicle. Used to test navigation and control algorithms.

Credit: Dylan Jones

a path for energy efficiency while also trying to gather information that will inform efficient path planning? Jones explained, "There will be trade-offs, that might include decisions such as sacrificing five hours early in the mission to save six hours later. Another possible direction is to look at cooperation between multiple vehicles. In this scenario, one vehicle 'wastes' energy by scouting ahead and relays information so the other vehicle(s) can take the most efficient path – working as a unit, this could mean a low shared energy cost by intelligently assigning goals and sharing information. But one of the hard parts about robotics research is getting this entire system to work together. It is often just as hard as building the initial algorithm in the first place."

Progressing AI in the Ocean Environment

Over the next decade advancements in this field will progress the industry closer towards the perfect synergy between humans and machines. The way we control underwater vehicles at present is relatively limited, leaving a lot of potential over the next few years for more autonomy to be built in. Jones added, "I think there will always be a human element in ocean robotics. Maybe the oceanographer will see something they find fascinating during a mission, and want to change the parameters to explore it further. That is a very hard question for us to solve algorithmically. It involves figuring out what the trade-offs are and how much do we care about one data set versus another."

In the ideal world, the technology should be in place that allows the human to focus on high-level tasks – such as considering how the data is useful and what other data the robots should be collecting. The robot, however, should manage the lower level calculations – for example, how does it best and most efficiently collect the data that the human wants.

Jones said, "Humans have an intuition about what is efficient – we know we don't want to go against the current – but they would struggle to do the calculations while traveling across the path. This is where the potential of robotics really shines. As engineers, we need to start thinking about how we can tease those tasks apart so the human can do what they're good at and the robots can do what they're good at. This is something else that our lab works on and it is ultimately what the industry should strive towards - the idea of shared autonomy. We need to learn how robots and humans best work together in the ocean environment so we can design solutions that allow us to collaborate in a way that strengthens both capabilities."

Acknowledgements
Dylan Jones, Oregon State University

Credit: Dylan Jones

Machines Infused with AI that Fly, Swarm and Dive

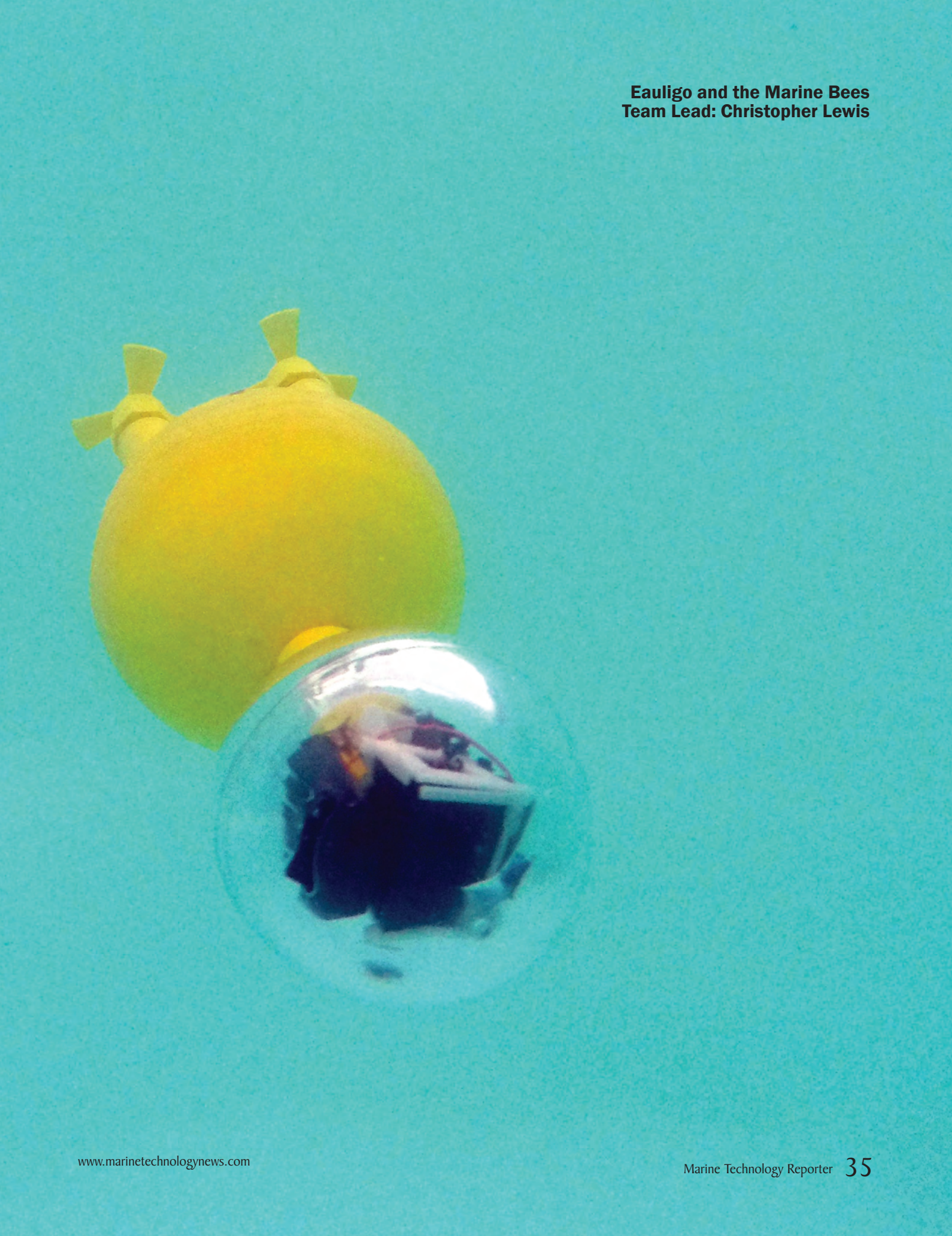
XPrize

Can mimicking insect behavior provide a way to map the ocean floor? Can robotic-controlled flying and diving drones be both bird-like and fish-like in the race to explore the ocean depths? The Shell Ocean Discovery XPRIZE has inspired a number of teams to explore.

By Dr. Jyotika I. Virmani

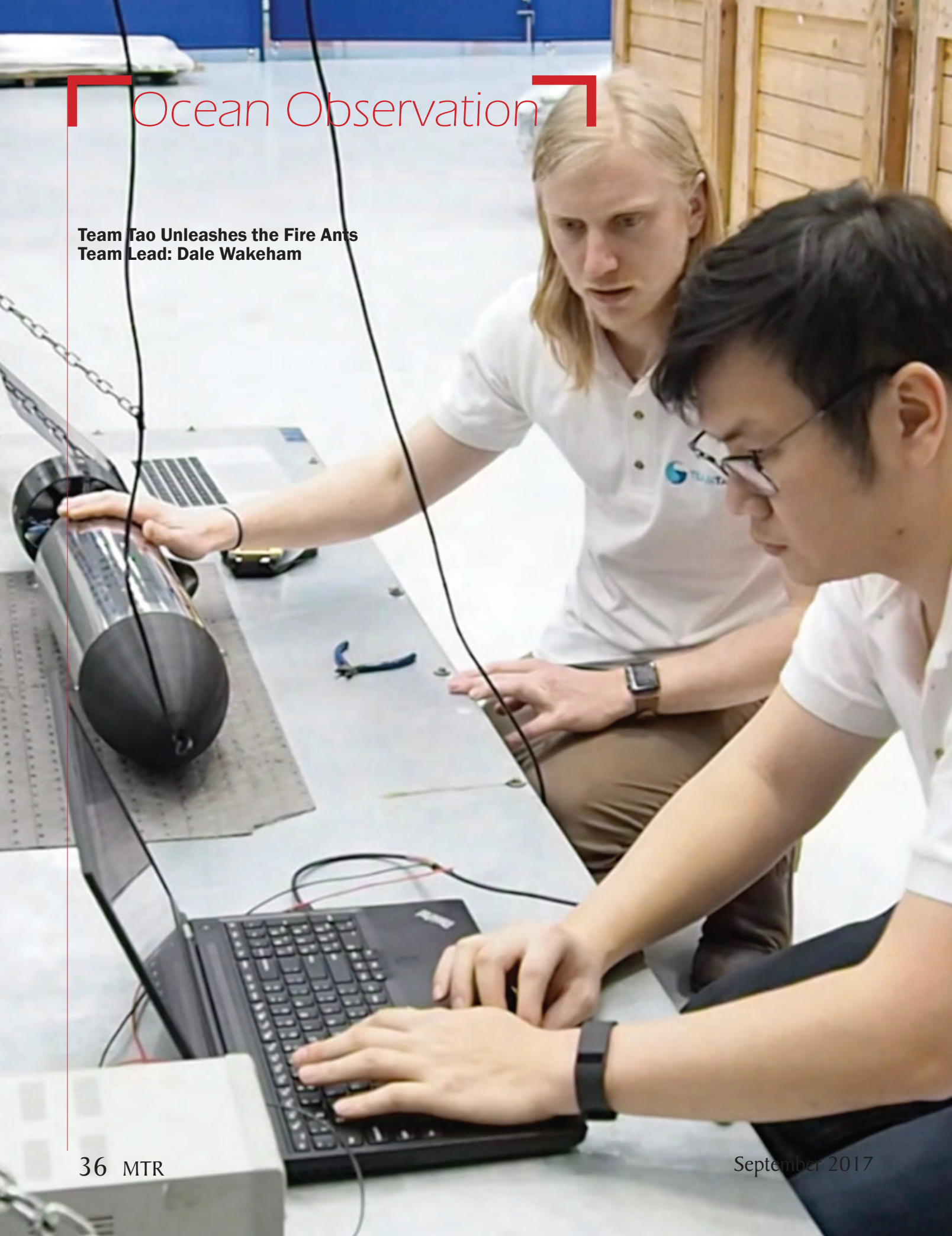
Senior Director, Planet & Environment, XPRIZE; with contributions from the XPRIZE teams

Eauligo and the Marine Bees
Team Lead: Christopher Lewis



Ocean Observation

Team Tao Unleashes the Fire Ants
Team Lead: Dale Wakeham



As a global group of 19 semifinalist teams in the Shell Ocean Discovery XPRIZE compete to create innovative autonomous technologies to image and chart the unknown in a cold, dark and hull-crushing undersea world at depths down to 4,000 meters, we look to the innovation that will advance our understanding of our planet.

In exploring the deep ocean, we're seeing that new robotic approaches can open doors for capturing collective imagination more quickly than ever before – providing a detailed glimpse of deep landscapes, sunken artifacts and little-seen life forms...or even discovering new organisms or aquatic life.

In this XPRIZE competition, teams are racing in a challenging timeline to take technology from concept to fully functioning system in 12 months. The goal? To enable high speed, high resolution mapping of a 500 square km2 area at a 2,000 meter depth in less than 16 hours. Teams moving on to the finals face mapping missions at 4,000 meter depths only 10 months later. On top of this, some teams are opting to compete to develop an underwater smart sniffer, the National Oceanic and Atmospheric Administration (NOAA) Bonus Prize to autonomously trace a chemical or biological signal to its source.

The technological approaches vary. There is typically a heavy artificial intelligence (AI) component in the overall solutions to allow for deep ocean decision making and undersea robot coordination for mapping. AI is also critical in the underwater smart sniffer, as the solution detects a signal and decides which direction it is coming from. Each team has taken a different approach in facing the challenge of how to address the primary goal and where to start. As one team mentioned recently, nature has been designing things a lot longer than we have, and has always been a good place for inspiration to solve engineering problems. Nature can be an innovative thought-starter, and more than one semifinalist team in the Shell Ocean Discovery XPRIZE is developing solutions that will feature biomimicry behaviors to build intelligent swarms, hives and heavy lift drone solutions that that can fly back and forth from the deep ocean competition mapping site.

Eauligo and the Marine Bees
Team Lead: Christopher Lewis

To compete in the Shell Ocean Discovery XPRIZE, the France-based Eauligo team has taken its inspiration from nature and plans to launch a horde of miniature robotic submarines that will mimic bee behavior. Watching bees going from flower to flower in a garden, the team leader observed each bee exploring on its own, and noticed that a large number of bees working simultaneously could cover a sizable area quickly.

Transferring bee actions from garden to undersea, the Eauligo team is building swarms comprised of robotic "Marine Bees" and surface "hives" to explore and image the ocean floor.

Just as the real bees leave their hive and fly looking for flowers then returning to tell the hive what they have found, Eauligo's Marine Bee submarines follow the same pattern. The Marine Bees dive down to the bottom of the ocean floor, spreading out to explore and map an area. They bring back their "nectar," which in this case are data and images. Returning to the surface they share the data with the other Marine Bees so they can autonomously decide where to explore next.

The design of each Marine Bee is also unique, using components and manufacturing techniques from mass-produced consumer products to drive down costs and create a low-cost unit. They have many features of full-sized autonomous underwater vehicles but are smaller and cheaper. The real advantage comes from putting hundreds of these small and simple robotic submarines together. Multiple Marine Bees provide scalable and low-cost ocean discovery.

As the ocean floor is unknown and unpredictable, it is impossible to program an autonomous vehicle to handle all conditions. However with Eauligo's solution if one of the Marine Bees fails to complete the task, they still have the results from the others, which provides a robust alternative to large, single vehicles.

Continuing the analogy further, the Marine Bees operate from hives, which in this case are autonomous surface ships that manage a cell of the autonomous craft. A hive will carry

the Marine Bees out to sea, launch them into the ocean and retrieve them after the dive. Mission control will communicate with the hive from shore, and the hive will communicate with the Marine Bees.

Duke's High Capacity Drones and Drop Pods
Team Lead: Martin Brooke

The Blue Devil Engineering team based out of Duke University is using drones, drop pods and machine learning to map the seafloor. Led by Professors Martin Brooke, Tyler Bletsch and Douglas Nowacek, the team is an enthusiastic group of high school, undergraduate and graduate students working together to develop their solution in classes and in their free time.

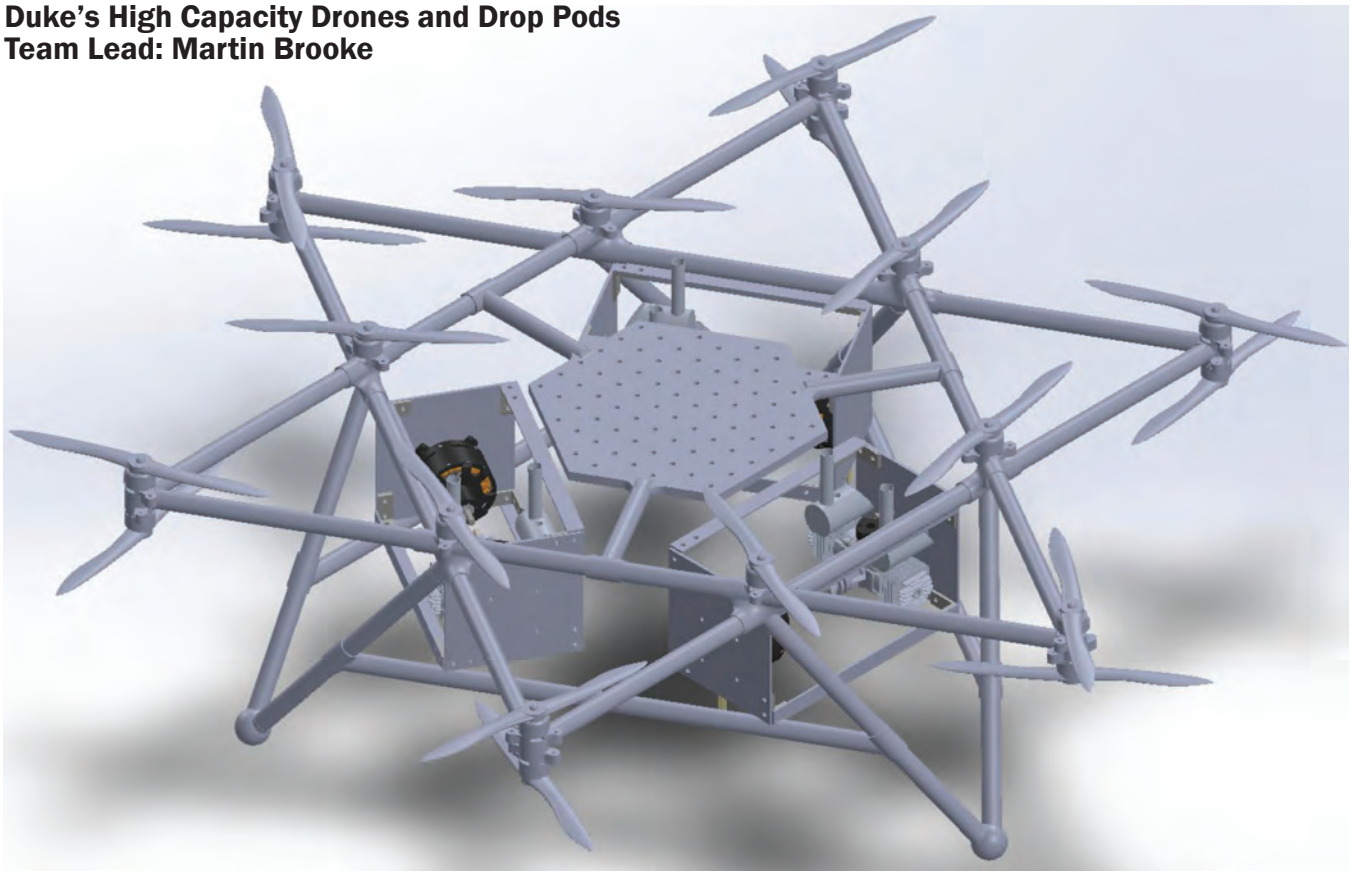
Their solution involves mapping the target area using a more than 100-element grid of water columns, in which each column is being mapped using a lightweight SONAR pod. The pod will be dropped into the ocean from a heavy lift drone into the center of the column and will then collect SONAR data for the column as it descends. Once it reaches the bottom, the pod ascends to the surface to be picked up by the drone while transmitting the collected information. The drone then drops the pod to another location to start the process again. The SONAR data will be processed as it is obtained via cloud-based servers to generate a bathymetry map.

Prototypes of its heavy lift drone have been tested in North Carolina's Duke Forest, and the team has been using the ocean off of the North Carolina coast to test pod prototypes to 2,000 meter depth for Round 1 of the contest. It's truly a team effort: undergraduate students are working on mapping algorithms in a Duke Data+ Summer Program and they are hosting 12 high school students with robotics experience to help with their final build. In the fall of 2017, about 40 undergraduate and graduate students will work on the project, deploying for Round 1 and prototyping for Round 2 of the contest.

The heavy lift drone uses 18 rotors and can lift 90 pounds. The team is developing hybrid gas-electric generators to provide the 18 kW of power the drone needs at full thrust which will allow for several hours of flight time over ocean waters. The drone is built from 3-D printed parts and carbon fiber tubes – getting the 3-D printed parts to withstand the strains of flight has been a challenge for the team's mechanical engineering students, but they have succeeded.

The lightweight diving SONAR pod uses low-cost, Rasp-

Duke's High Capacity Drones and Drop Pods
Team Lead: Martin Brooke



berry Pi-based electronics encased in epoxy-filled 3D printed shells to achieve a system capable of surviving 2,000 meters for Round 1. Electronics component operations have been tested at depths in both a pressure chamber at Duke and at sea beyond the continental shelf off the North Carolina coast.

The algorithms for reconstructing maps from the diving pod SONAR data are being designed with Synthetic Aperture SONAR techniques like back projection and machine learning using Bellhop simulations of the SONAR reflections. Their SONAR systems operation, as the pod descends, is different enough from most published SONAR mapping applications to require the team to innovate to achieve success.

Team Tao Unleashes the Fire Ants

Team Lead: Dale Wakeham

Team Tao brings together industry experts from U.K. subsea engineering specialist Soil Machine Dynamics Ltd. (SMD) and Newcastle University who together are developing an autonomous swarm system for rapid surface to deep ocean exploration. Beyond this small core team, there is an extended team of six technical consultants, a group of student engineers and a panel of six academic and industry advisors. Their approach to the Shell Ocean Discovery XPRIZE involves international collaboration through partnerships with companies and institutes in the U.K., China and the U.S.

Dale Wakeham, Team Tao's lead and an R&D engineer at SMD, originally put forward the idea of competing in the XPRIZE challenge to SMD's CTO, Chris Wilkinson in early 2016. By August of that year they were in China brainstorming concepts with their parent company, CRRC Times Electric. Wakeham explains that in the U.K. and China both were speaking to a wide range of industry experts but were unable to find any market solutions that were anywhere near the capabilities that XPRIZE required, so they came to the conclusion that they needed to come up with an entirely new survey method.

Wakeham remembers seeing a documentary showing that fire ants are individually unable to swim, but as a colony they can cross water. From the shore they start walking over each other to form a living raft and eventually bridge the water. The relatively simple ant forms part of a complex system that is able to complete an otherwise unachievable goal. Wakeham sees this solution as extremely scalable: the more ants there are, the larger the body of water they can cross but, if one ant becomes detached or lost, the mechanism still continues to function. That was the light bulb moment when Wakeham knew Team Tao's swarm needed to share these principles.

Conventional industrial autonomous underwater vehicle (AUV) systems involve an AUV deployed from a large manned vessel. The AUVs typically follow a 'lawn mower' path, scanning until their batteries are low, where the AUV would then resurface for recharging and the download of its data. Team Tao, dissatisfied with the costs, size and rate of scan of these systems, set out to create a compact and cost-effective autonomous platform that can rapidly sense and survey the oceans.

The system uses two main components: the BEMs (Bathypelagic Excursion Module), a swarm of around 20 vertically swimming AUVs and the autonomous surface vessel (ASV), a 'vending machine' style ASV that is responsible for horizontal transport, data handling and communications. A drone also provides air support.

Hua-Khee Chan, a research associate at Newcastle University's School of Electrical & Electronic Engineering and Team Tao core team member, sees benefits to the swarm approach, which allows a cyclic, continual operation without any system downtime and saves considerable amounts of time and money.

One of the benefits of making the swarm travel vertically instead of horizontally, according to Chan, allows the team to leave out a lot of complex technology because dive time isn't as long – meaning they can go with smaller batteries, cheaper technologies and consumer-grade electronics. Newcastle University also has a long history of creating sensors, and Team Tao is using this knowledge to its fullest potential to drive down the costs of typically expensive subsea electronics.

Currently in the final stages of in-tank tests, Team Tao is readying system operations in open waters.

The Mapping-While-Drilling Evolution

GeoSphere

By Claudio Paschoa

Logging-while-drilling (LWD) technologies have evolved significantly in the past decade. Today they integrate sophisticated algorithms that take advantage of the ever-increasing technical complexity combining mechanical, electrical and software systems that are implemented downhole. These achievements help the users gain a better understanding of the reservoir while bring drilling into a new area of efficiency and cost savings. *Marine Technology Reporter's* Correspondent in Brazil spoke to Jean Seydoux, Program Manager for Advanced Reservoir Mapping Technologies for Drilling and Measurement at Schlumberger, about their GeoSphere Mapping-While-Drilling Service.

What were the breakthroughs in this technology's development along the last five years?

In 2014, Schlumberger introduced the GeoSphere technology, the first-ever reservoir mapping-while-drilling service that enables customers to map their reservoirs using unprecedented depth of investigation measurements around the wellbore coupled with a novel mathematical inversion methodology.

Using deep, directional electromagnetic measurements, the GeoSphere service reveals subsurface-bedding and fluid-contact details more than 100 ft [30 m] from the wellbore. This reservoir-scale view provides an unprecedented depth of investigation, enabling operators to optimize landing, maximize reservoir exposure, and refine field development plans. By integrating real-time reservoir maps with seismic surveys, interpretation of reservoir structure and geometry can be refined, revolutionizing field development strategy.

What different fields of research were involved in developing the GeoSphere reservoir mapping-while-drilling service?

Mechanical, electrical, and software engineering that deliver deep directional measurements are at the core of the hardware development.

From these measurements, a resistivity map of the reservoir is inverted using a novel stochastic process that allows the drilling team and geoscientists (such as petrophysicists, geologists and reservoir engineers) to first understand and then steer within a geological structure tens of meters away from the borehole—all in real time.

By revealing details of structural dips and fluid boundaries in geological structures, the real-time mapping data provides operators with information critical to avoiding undesired exits into nonproductive layers.

How does mapping-while-drilling system work?

The GeoSphere mapping-while-drilling service follows a standard pre-job modeling, real-time execution and post-job

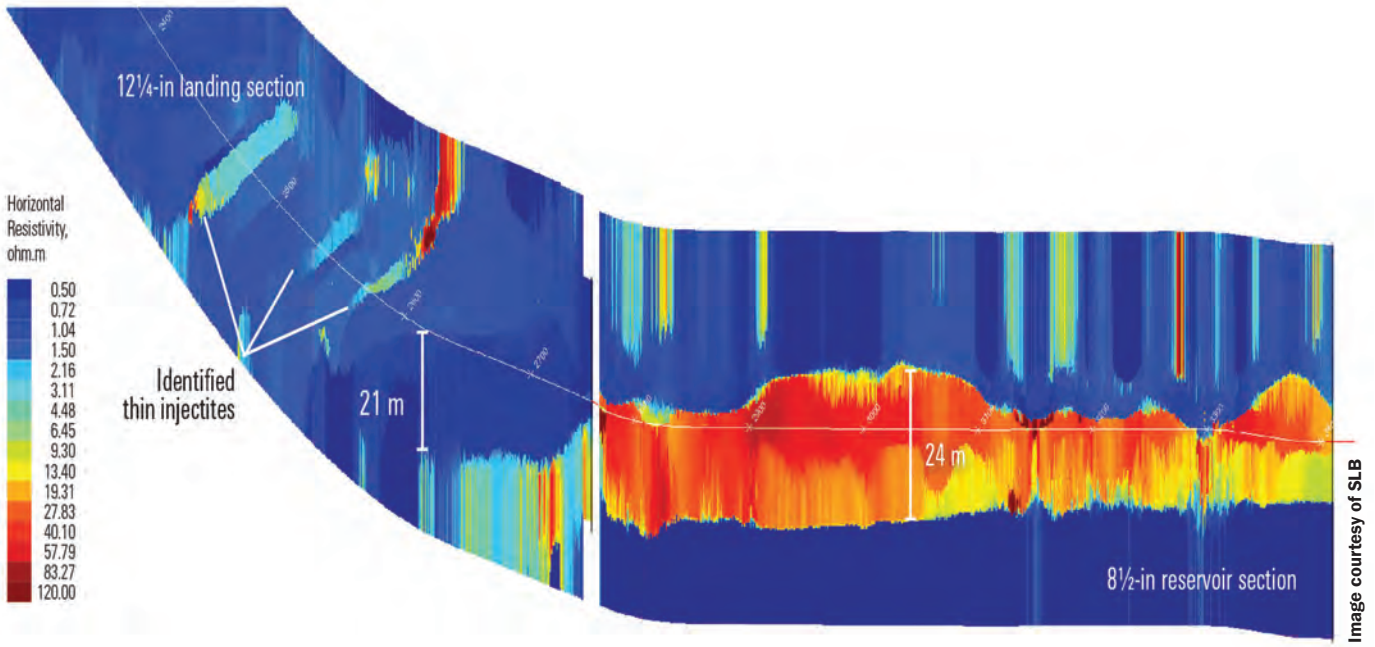


Image courtesy of SLB

GeoSphere service outputs for the landing and reservoir sections of a producer well in the Balder field drilling campaign. During landing, the thin injectite sands were identified and the top of the massive sands was detected at 21-m [69-ft] TVD away. Throughout the reservoir section, the entire oil column—from the top of the reservoir to the OWC—was mapped and the well path was geosteered to maximize production.

evaluation that characterize the well placement process but with a much deeper understanding of the reservoir structure.

When it comes to steering, the GeoSphere service detects individual layers in horizontal sections radially — as mentioned earlier—more than 100 ft [30 m] from the wellbore, exceeding the formation coverage of conventional logging-while drilling technologies. Combined with surface seismic data, this amount of zonal coverage gives geoscientists and drilling engineers the capability to extend laterals — even in the most complex geological settings — within the sweet spot.

As for mapping, the GeoSphere service maps the reservoir top and base, providing data on the presence of lateral heterogeneities, subsurface unconformities and reservoir geometry.

Asset teams can then integrate all data from the service to optimize production and reservoir management. With complete well development plans, operators have a greater likelihood of successfully enhancing recovery techniques and exceeding expectations for the reservoir.

Finally, mapping data from the GeoSphere service can be integrated into 3D reservoir models to optimize drilling operations and completion designs, leading to production improvement and better field development strategies.

What are the main advantages of using the GeoSphere service?

One of the main advantages of the service is to avoid drilling a pilot hole, which is a costly operation, especially when drilling offshore. Pilot holes are often drilled to evaluate the formation, but that doesn't necessarily mitigate risks in shallow or complex reservoir. Productivity of the well can be impacted by shallow landings, where too much of the section is drilled in the overburden, which becomes a major challenge for completions, or deep landings, causing early water breakthroughs and resulting in more attic oil.

By dynamically adjusting the trajectory of the well based on the surrounding geology, the GeoSphere service is much more efficient than the traditional pilot hole operations and allows a more optimum positioning of the well. Due to the extended radial depth of investigation, the service enables the operators to see more than 100 ft around the wellbore, revealing the reservoir boundaries ahead of time to accurately land the well. This eliminates the need for pilot hole drilling and results in more efficient well construction.

What were the main challenges in developing the mapping-while-drilling service?

Well placement poses a wide range of critical issues, such as adjusting to reservoir uncertainties and various drilling risks. To address these challenges, the technology was designed to be configurable and flexible to maximize its envelope of applications. The GeoSphere service is the first drilling technology with the sensors and frequencies that can be optimized to a specific application such as landing or navigation within a reservoir in low to very high resistivity regimes.

This translates into the maximized reservoir exposure, ability to stay in the sweet spot and the modification of field development plans. The operators now have the right tools to

GeoSphere data log shows the layered formation structure in the well.

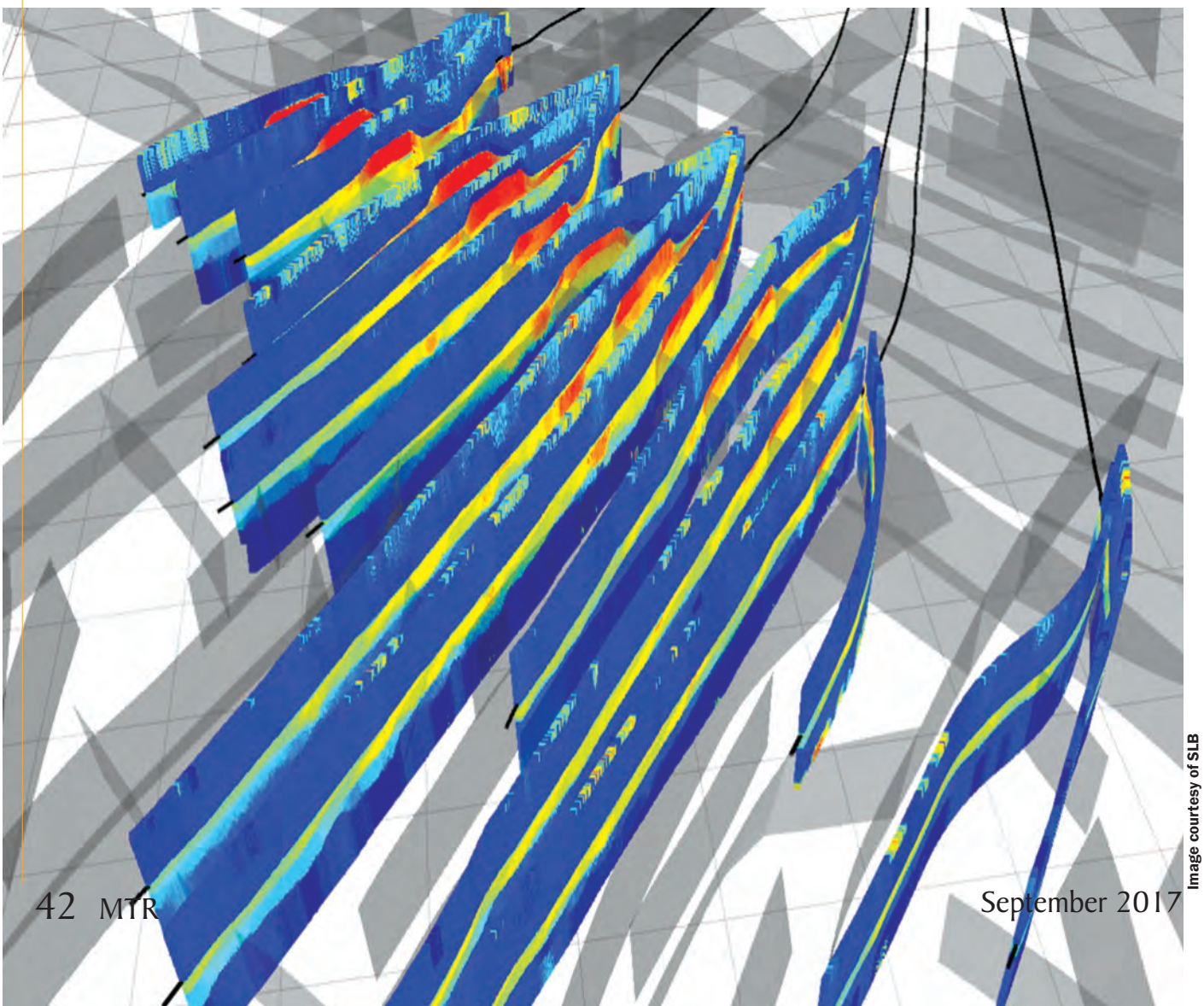


Image courtesy of SLB

fully understand their reservoirs in an efficient and cost-effective manner.

What are the main components of the mapping-while-drilling service?

The main components of the service, which is adaptable to the challenges of the well, consist of separate drilling subs hosting electromagnetic transmitters and receiver configured in a standard bottom hole assemblydrill string. When drilling, the data acquired by the system is transmitted onshore and processed on a high power computer cluster to provide a continuous resistivity map of the reservoir that helps the operator to take well placement decisions in real time.

Two offshore case studies are worth mentioning here. In the Balder field, North Sea, the GeoSphere reservoir mapping-while-drilling service enabled the operator to eliminate the need for pilot holes and improve landing success. The challenge was to distinguish targeted sands from nontargeted sands when drilling through a complex formation to land effectively and optimize production while eliminating the need for costly pilot holes.

The GeoSphere service mapped the top of the massive sands from more than 20-m [66-ft] true vertical depth above, ensuring a safer and more optimal landing result. Also, the operator was able to detect the oil/water contact while landing the 12 1/4-in section prior to penetrating the reservoir.

In the Caspian Sea, the GeoSphere service mapped formation boundaries that were located up to 24 m from the wellbore, allowing the operator to geosteer the well with only five trajectory changes compared with an average 15-20 in previous wells. In this project, Schlumberger achieved world record for the new service, logging 4,908 m in one run, 88.5% net to gross.

How does mapping-while-drilling help increase ROP, improve wellbore stability and hole quality, and optimize well placement?

By seeing geological and reservoir features deeper and earlier the wellbore tortuosity is optimized and correction to the trajectory can be smoother and more efficient. The outcome is a higher ROP with a much improved wellbore position with respect to the main reservoir target.

How and where is mapping-while-drilling being used?

GeoSphere was first used in the Campos basin, offshore Brazil, for landing, pilot hole avoidance, and horizontal navigation by various operators, accounting for approximately 20% of the total world application so far.

What were the benefits Schlumberger found in using mapping-while-drilling?

A close interaction with operators both during the pre-job phase and in real time is paramount. The collaborative approach enables the Schlumberger experts to gain a much deeper understanding of the operator's challenges from landing to reservoir characterization. Previous challenges associated with well placement that were unattainable before — such as drilling in very thin, discontinued, or compartmentalized reservoirs — can now be fully addressed.

The offshore Brazil case study demonstrates how the reservoir mapping-while-drilling service investigated 100 ft from wellbore in real time to detect reservoir boundaries. As a result, the operator accurately landed three wells, each with multiple targets in channel sands, leading to optimized drain trajectories. In the Balder field, North Sea, the GeoSphere service enabled the operator to eliminate the need for pilot holes and improve landing success.

In the Barents Sea, the GeoSphere service revealed that the reservoir was thicker but more heterogeneous than anticipated—useful information for geosteering and for postwell evaluation activity.

What does the future look like?

The service is rapidly becoming a standard application to reduce drilling risks and understand the reservoir to the fullest. Such a service is needed as operators discover new opportunities and face different challenges in the ever-changing oil and gas environment.

CARTHE drifter deployment from a small boat offshore Miami.

GreenWave Instruments LLC

Meet the CARTHE Drifter

By Cedric Guigand, Guillaume Novelli, Charles Cousin, Edward Ryan, Tamay Ozgokmen

Surface currents in the upper 1 ocean are very important in driving the fate of marine debris and pollutants but are also challenging to measure. Tracking the upper ocean in an effective manner may require massive deployment of GPS tracked drifter buoys, which until now were expensive, cumbersome and quite polluting themselves (i.e. made of PVC, ABS and Nylon). The CARTHE drifter is an answer to the need for a compact, user-friendly, robust, yet eco-friendly solution. Scientists with the Consortium for Advanced Research on Transport of Hydrocarbon in the Environment (CARTHE), in collaboration with the ocean engineering company Bellamare LLC, spent two years testing different structures and materials to develop a practical, cost-efficient and biodegradable drifter design. The CARTHE drifter is the first environmentally-friendly drifter ever designed with 85% of its components being biodegradable in seawater. Calibrated at the University of Miami's SUSTAIN wave-tank facility, the low cost, small form factor instrument weights 4 kilograms standing at only 70 cm high when fully assembled. It comes in an easy to assemble, three components, kit to reduce storage space during shipment and deployment at sea.

Ocean plastic pollution is a rapidly-emerging global crisis. Several million tons of plastics are discarded into marine environments every year and accumulate in oceanic regions. Petroleum based plastics have a very low biodegradability and stay in the marine environment was long periods of time (probably hundreds of years). The quantities and durability of plastics debris in the marine environment are some of the unforeseen consequences of the qualities that made these polymers so ubiquitous in our everyday life. Plastics are now representing 60% to 90% of marine debris and have worldwide documented harmful effect on marine biota. These facts directed design efforts toward a biodegradable, strong, easily workable and readily available material. The answer seems to be found in the recent advances in biochemistry, which have produced new biodegradable polymers. Notably, polyhydroxyalkanoates (PHAs), were discovered to be non-toxic and biodegradable thermoplastics.

PHAs can be produced by engineered bacteria fed with corn sugar inside large fermentation tanks. Like mammals store fat, these bacteria store excess energy from sugar into PHA, which is later extracted. PHA products were of particular interest to our drifter design because not only they were readily available but also had met the American Society for Testing of Materials (ASTM) standard for biodegradability in the marine environment. According to ASTM biodegradability definition,

GreenWave Instruments LLC

CARTHE drifter deployment in the Gulf of Mexico during the LASER experiment.

GreenWave Instruments LLC

Drifter getting ready for deployment in the Gulf of Mexico during SPLASH experiment.

any biodegradable plastic should be ‘‘capable of undergoing decomposition into carbon dioxide, methane, water, inorganic compounds or biomass in which the predominant mechanism is the enzymatic action of microorganisms, that can be measured by standard tests in a specified period of time, reflecting available disposal condition.”

PHAs being thermoplastics with strong mechanical properties similar to other commonly used plastics seemed very well suited for the construction of sacrificial oceanographic instrumentation. PHAs also have the required qualities for industrial injection molding, an industrial technique allowing for fast production of large quantities of pieces. In particular, the use of injection molding allows for the fabrication of large quantities with very low overheads in record time, thus reducing the price of the instrument and increasing large volume availability.

The instrument is activated by a magnetic switch and can send its position every 5 minutes for a period of up to 3 months with meter accuracy using very-low cost GlobalStar Simplex telemetry systems. The client can receive the data in real-time through the Pacific Gyre LLC website, the official distributor of CARTHE drifters.

Moreover, the “drogue-less” torus float can be deployed alone for surface oil slick tracking purposes. An air-dropped version, using a biodegradable parachute, is coming out next year to increase the deployment capabilities of the instrument.

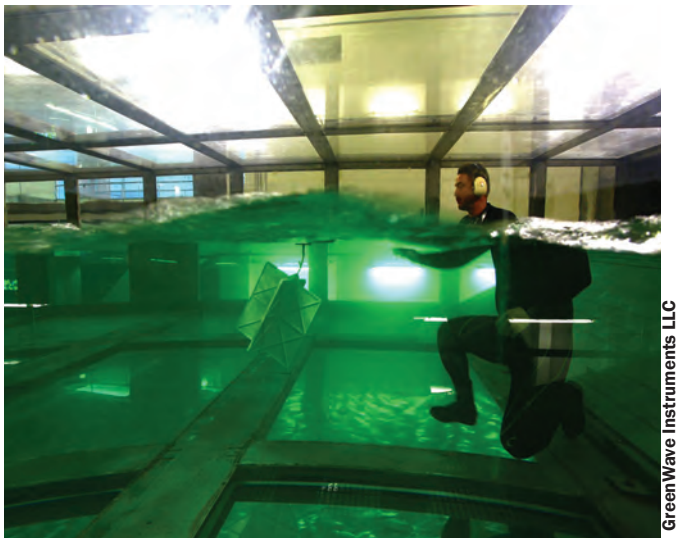
Typical applications are physical and biological oceanography, search and rescue missions, marine pollution tracking, as well as surface current monitoring for the offshore industry and the Navy for purposes of navigation and operational risk reduction. More than 1,500 of these drifters were recently deployed in two large scale experiments (named LASER and SPLASH) conducted by CARTHE to study the upper ocean processes that control the transport of hydrocarbons in the environment. The CARTHE drifters have also been used in various projects from sea turtle research to Arctic research in the Bering Sea, as well as source pollution monitoring in inlets and Port of Miami.

The CARTHE drifter is manufactured by GreenWave Instruments LLC (Miami) and distributed by Pacific Gyre LLC (San Diego). The CARTHE consortium is funded by the Gulf of Mexico Research Initiative (GOMRI).

Specifications:

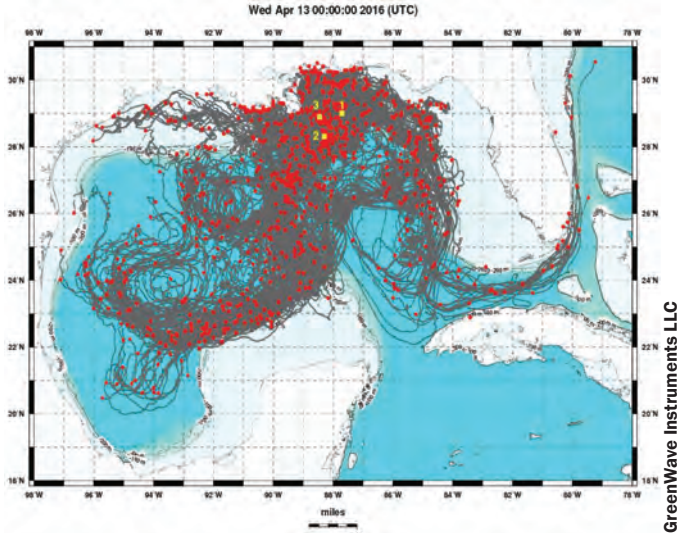
Telemetry:	GlobalStar Simplex
Position:	Every 5 minutes
Battery:	6 Volts Alkaline
Battery Life:	Up to 3 months
Material:	PHA biodegradable plastic
Deployment:	Magnetic switch activation
Size:	70cm tall x 38cm wide
Drogue mid-depth:	40cm
Float:	38cm diameter torus
Weight:	4 Kg in air
Assembly:	3-part kit

www.greenwaveinstruments.com
www.pacificgyre.com



GreenWave Instruments LLC

Full scale testing at the SUSTAIN wave-tank facility at the University of Miami, RSMAS.



GreenWave Instruments LLC

Three-month long trajectories of 1000 drifter units from the LASER field experiment.

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Photos: Nortek

Reliable and constant measurements of environmental currents and other oceanographic environmental conditions can markedly improve the performance of fish farms in Chile.

The Aquadopp Profiler is a highly versatile Acoustic Doppler Current Profiler used by the fish farming industry to optimize production and operations.

Nortek's Realfish system (also known as AOS) gives the fish farming industry online access to monitoring of currents, oxygen, salinity and temperature.

Chile's Fish Farms

The right measurement technology can help Chile's aquaculture industry fulfill its potential

Climate change is just one of the challenges that ports in Chile increasingly have to deal with, and an investment in the latest Doppler technology and online systems has proven to be a significant benefit for its ports. How can Chile's aquaculture industry maximize this technology's potential?

From the early 1990s to 2007, Chile's aquaculture took off, and by 2006 it was producing 38 percent of the world's salmon. Now, the country produces 1.4-1.5 million tons of salmon a year, putting it on a par with the world's biggest producer, Norway. But there is still significant potential for Chile to run its aquaculture operations more efficiently and profitably.

"Doppler technology has already helped improve safety and efficiency in Chilean ports. Now, the country has the potential to improve the performance of its aquaculture by fully adopting Doppler technology," said Christian Haag, managing director of oceanographic service provider Mariscope Ingenieria SPA in Chile, and a representative for Doppler technology provider Nortek in the Chilean market.

Why is measuring waves and currents with Doppler technology a key part of making aquaculture more efficient?

Reducing Aquaculture Food Loss

Measuring waves and currents helps with issues such as calculating the most effective location of the cages' moorings, the shape of those cages, and the position of floating barges. It also helps fish farmers economize on fish fodder.

"Typically, fishmeal is unnecessarily wasted during the feeding process, as currents draw the pellets through the cages' netting. As an example, constant measuring giving real-time data can be supplied via Nortek's Aquadopp current profiler and the Autonomous Online System (AOS), in addition to other sensors (for oxygen, salinity and temperature)," Haag explained. Data from these systems inform when and from what position food can best be released, and where and when to position the cameras which reveal when the fish finished feeding. Haag said Mariscope Ingenieria SPA has done a study that found that using Doppler technology and real-time data could reduce food loss by up to 20 percent – a big financial saving for any fish farming operator.

Lack of Reliable Data

At the moment, many aquaculture sites in Chile still rely on spot measurements, meaning that they really don't have enough reliable data to make informed decisions, and guesswork comes into play.

The situation is somewhat different in Norway. The contrast between efficiency levels in Norway and Chile's aquaculture can partly be put down to the widespread use of top-of-the-range technology. In Norway, many fish farmers have installed permanent measurement systems that supply constant, real-time data and allow for much more informed decisions to be made.

Nortek has supplied approximately 300 AOS (or Realfish) systems to Norway's fish farming sites. The Nortek AOS system offers online access data on oxygen, salinity and temperature, as well as ocean currents and wave data from any coastal location.

"It does not require significant engineering resources and once deployed, the system will be up and running in a matter of minutes. It transmits data collected via satellite to a software developed specifically for the aquaculture industry," Haag said.

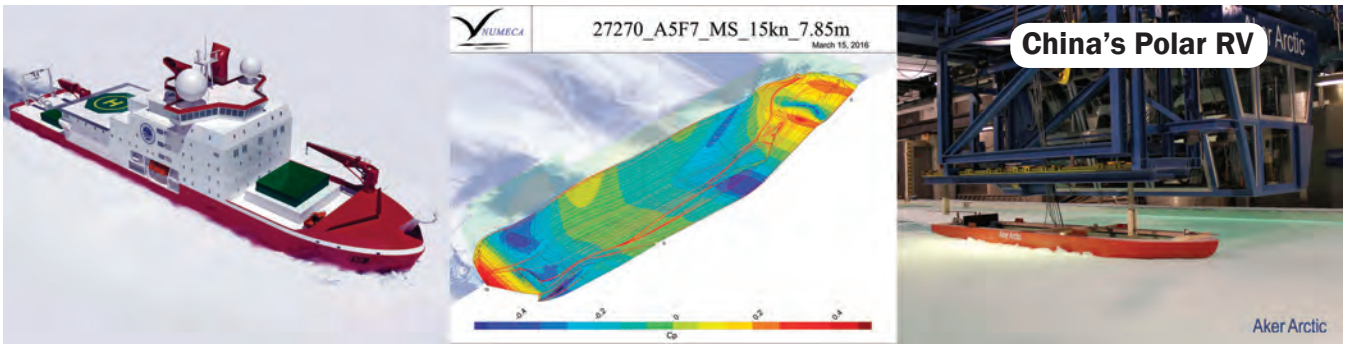
This system generates daily reports so that fish farms can document that they operate according to standards set out by governmental organizations, or nongovernmental organizations such as the Aquaculture Stewardship Council (ASC).

"As an example, there are least 100 ASC-certified fish farming sites in the Chile, most of which would instantly become more efficient by adopting the AOS system in combination with current profilers," Haag said.

www.nortekgroup.com

The Fleet is In

A wave of new and innovative research vessels are set to help scientists enhance their understanding of the oceans. *MTR* profiles several of these ships currently in designe and construction across the globe.



Aker Arctic

RRS Sir David Attenborough

The U.K.'s new polar research ship rose to fame when Boaty McBoatface took the internet by storm as the leading vote getter in an online naming contest. The U.K.'s Natural Environment Research Council (NERC) eventually chose to call the ship RRS Sir David Attenborough, a name better fit for a $256 million high-tech research ship (though the Boaty McBoatface name will live on via an AUV onboard).

RRS Sir David Attenborough will be one of the world's most technologically advanced research vessels when it sets sail in 2019, operated by British Antarctic Survey. Currently under construction at England's Cammell Laird shipyard, the Rolls-Royce designed vessel will replace RRS Ernest Shackleton and RRS James Clark Ross to aid extended scientific research missions in both Antarctica and the Arctic.

The Polar Code 4 ice class vessel will be equipped with wide range of specialist scientific facilities, instruments and laboratories enabling scientists to study the ocean, seafloor and atmosphere. Robotic submarines and marine gliders will collect data on ocean conditions and marine biology and deliver it to scientists working in the ship's on-board laboratories, while airborne robots and onboard environmental monitoring systems will provide detailed information on the surrounding polar environment.

RRS Sir David Attenborough

Length:.....128m
Beam:.....24m
Weight:.....15,000gt
Scientific cargo: ..... Approx. 900 cu. m.
Endurance: ..... 60 days (Polar Regions)
Range: .....19,000nm at 13 knots (24 km/h) cruising speed; more than enough for a return trip from England to Rothera Research Station, or to circle the entire Antarctic continent twice
Icebreaking capability: .....Up to 1m thick at 3 knots (5.6 km/h)
Crew: .... Approx. 30 +accommodation for up to 60 scientists and staff

RV Kronprins Haakon

A new oceanographic icebreaker being built for the Norwegian Polar Institute (NPI) was launched by shipbuilder Fincantieri in Italy earlier this year. The $177 million vessel, RV Kronprins Haakon, due for delivery by the end of 2017, will be owned by the NPI, while the Institute of Marine Research (IMR) will have operational responsibility and the University of Tromsø will be her main user.

The high-tech PC 3 class icebreaker vessel was designed by Rolls-Royce Marine to operate year round in polar waters, providing a high-tech facility for the study of the marine environment. At 100 meters long and 21 meters wide, with a gross tonnage of about 9,000 tons, Kronprins Haakon will be able to accommodate 55 people (including research personnel, students and crew) in 38 cabins. Its hangar at the bow will have two helicopters and the unit will be equipped with a ROV, AUV and moon pool, among other high-tech equipment.

Kronprins Haakon will have a cruise speed of 15 knots and will be able to move on independently through ice thick up to one meter and with particular silence requirements to avoid disturbing the sea environment. The ship was built according to criteria ensuring minimum environmental impact and reduced radiation of noise underwater, so as to allow studies on fish and marine mammals. She will be able to carry out its oceanographic

Rolls-Royce

and hydrographic research activities in any area of operation. Kronprins Haakon will set sail for scientific expeditions starting in 2018.

LNG Fueled Research Ship for Germany

The Fassmer shipyard in Germany is currently constructing a new research vessel to be owned by Bundesamt für Seeschifffahrt und Hydrographie (BSH), the Federal Maritime and Hydrographic Agency. The new 75-meter-long ship will replace her 30 year old namesake, the Atair, and will be the first German research vessel operating on liquefied natural gas (LNG) fuel.

Wärtsilä will supply two six-cylinder Wärtsilä 20DF dual-fuel engines capable of running on either LNG or conventional liquid fuels, one six-cylinder Wärtsilä 20 engine, two exhaust cleaning systems and a Wärtsilä LNGPac fuel storage, supply and control system. The ship fulfills the DNVGL classification society's 'Silent R' rating, thus allowing the sonar equipment to be used without disturbance from underwater radiated engine noise.

Kongsberg's Integrated Vessel Concept for research vessels delivers a fully integrated operator environment, equipped with high level acoustic data acquisition, dynamic positioning, propulsion control, navigation and vessel automation.

Atair II will operate in the North Sea and the Baltic Sea, conducting hydrographic surveys and wreck search operations in addition to marine environmental monitoring, as well as the technical testing of navigation and radar equipment. The vessel is scheduled to enter service in early 2020.

Regional Class Research Vessels

Gulf Island Fabrication, Inc. subsidiary Gulf Island Shipyards, LLC, received a contract from Oregon State University (OSU) for the construction of a Regional Class Research Vessel (RCRV) with an option for two additional vessels. OSU has engaged with naval architecture and engineering firm Glosten to lead the design and construction of the next class of ocean-going research vessels for the National Science Foundation (NSF).

These state-of-the-art 193-foot ships will be highly flexible, multi-mission platforms that maximize energy efficient design concepts. The first vessel will be built in Houma, La, and will be delivered to OSU in the fourth quarter of 2020. This vessel will be ABS Ice-Class C0 and DPS-1, Green-Marine Certified, acoustically quiet, and carry up to 29 crew and embarked scientists.

RCRV will have the ability to collect high quality and high resolution ocean floor and subfloor acoustic data (multibeam) from near shore to midwater depths. RCRV will also introduce a deployable centerboard that will, with high positional precision, provide at versatile platform on to which a wide variety of acoustical sensors can be easily installed based on specific mission requirements.

The first RCRV will be operated by OSU on the West Coast as part of the University-Oceanographic Laboratory System (UNOLS).

China's New Polar Research Vessel

Construction on China's new state-of-the-art polar research

Atair II

Wärtsilä

Regional Class RV

OSU

ship is underway at Jiangnan Shipyard in Shanghai, China, with delivery scheduled for 2019.

In 2012, the Polar Research Institute of China (PRIC) awarded a contract for the concept and basic design of the research icebreaker to Aker Arctic, who tailored the design for specific scientific missions in the Arctic and Antarctic. After the concept had been developed, Aker Arctic performed model tests in open water and ice at its Helsinki laboratory in order to verify the vessel's performance.

The new vessel will be about 122 m long and 22 m wide, and includes extensive scientific outfit including both wet and dry laboratories, a large aft working deck served by several cranes and winches, and a moon pool with scientific hangar that allows deploying CTD Rossette and other scientific instruments in ice-covered seas. Comfortable accommodation is provided for up to 90 scientists and crew. Large forward cargo hold, heavy crane and cargo fuel tanks allow the vessel to carry out resupply missions to scientific research stations. The aviation facilities include a landing platform and a hangar for two helicopters.

The Polar Class 3 icebreaker will be capable of continuously breaking up to 1.5 m thick level ice with a 20 cm snow cover in both ahead and astern directions. A special box keel will provide a disturbance-free flow environment for bottom-mounted scientific instruments in both open water and ice. The diesel-electric power plant and propulsion system, which consists of four main generating sets, two 7.5 MW azimuth propulsion units and two transverse bow thrusters, will provide the vessel with redundant DP2 class station keeping capability.

Duke Gains Funding for New Research Vessel

Duke University said it has received $11 million for the construction and operation of a new state-of-the-art vessel that will expand teaching and research capabilities at its marine lab. The gift to the Nicholas School of the Environment from the Grainger Family Descendants Fund, a donor-advised fund at The Chicago Community Trust, provides $5 million to build the new 68-foot oceangoing research vessel and an additional $6 million to support operating costs.

The ship will have wet labs and dry labs, oceanographic equipment, a galley and sleeping quarters. It will be an ocean-going classroom to train undergraduate and graduate students in oceanography and marine biology at the Duke Marine Lab at Beaufort, N.C.

It will also be used to support science outreach programs for local K-12 teachers, students and community members. Researchers and instructors from other institutions will also be able to charter the vessel for scientific or educational purposes. Duke said its marine lab has been without a large research vessel since two of its boats were retired—the 135-foot Cape Hatteras in 2013 and the 50-foot Susan Hudson in 2014. Faculty members have since been unable to regularly take students offshore or participate in oceanographic work.

The new vessel will allow researchers and other institutions to conduct research along the Atlantic seaboard in a wide range of vital fields, including marine ecology and conservation, biological oceanography and renewable ocean energy development. Design and construction is expected to take about two years. A shipyard has yet to chosen.

Products: Software Solutions

QPS Inc.

QPS makes software for collection, post processing and visualization of maritime geomatic data. Its products partner third party products to solve problems and gain efficiencies for maritime related survey business.

Qastor is an Electronic Chart Software (ECS) that enables navigation, piloting and precise docking, as well as several other applications such as oil and gas FPSO/SPM mooring, patrol vessel and tugboat operations.

QINSy is a software suite used for various types of maritime geomatic surveys, ranging from simple single beam surveys up to the very complex offshore construction works.

Qimera (pictured) is designed as an easy to use yet powerful sonar data processing application. Built using core QPS technologies, As well as QINSy projects, Qimera supports the major raw sonar file formats and by working with the Dynamic Workflow it revolutionizes the way data is handled and the operator experience when processing hydrographic data. Fledermaus interacts in 4D with geographical datasets, providing added value in data processing efficiency, quality control accuracy, data analysis completeness and project integration that promotes clear communication.

AgileTek

Subsea engineering analysis consultancy AgileTek produced an online platform AELCloud that is designed to run analysis and simulations on clients' local servers and the cloud to reduce required simulation time and ensure information is high-quality and traceable.

A recent project for Fugro required many simulated subsea power cable installation operations to be performed to verify procedures, component sizes and weather windows. For this, AgileTek rolled out AELCloud and was able to scale server capacity on demand. On this subsea installation project alone, AgileTek ran approximately 27,000 OrcaFlex simulations which equated to around 57,000 hours, or just over six years of simulation time. Eight terabytes of simulation file binary data were saved, and AELCloud processed a total of 1.5 billion data points for critical metrics in the system. AELCloud, which took about a year to develop, enables all data transfer, results specification, results post-processing and reporting to be performed automatically on a secure web application, effectively slashing the number of manual steps required to report results.

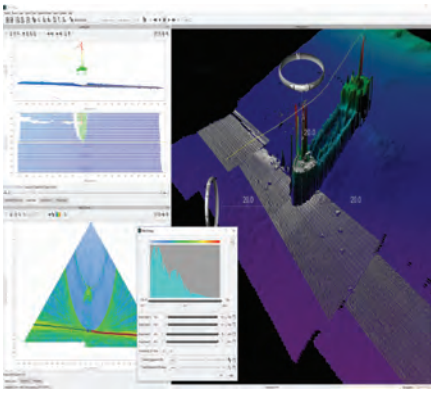
TCarta Marine

TCarta Marine LLC provides bathymetric and marine data sets extending from the shallow coastal zone to the continental shelf. Its product lines include high-resolution satellite-derived water depth and seafloor map products, as well as 90 meter and 30 meter GIS-ready bathymetric data aggregated from numerous information sources. Its new BATHYMETICS portal is a unique instantly accessible off the shelf global Bathymetry product.

TCarta Marine is now working in partnership with DHI Group to create a global satellite derived bathymetry database. All depths are extracted from DigitalGlobe WorldView-2 and WorldView-3 multi-spectral satellite imagery using a customized, proprietary algorithm, and then a modeled tidal adjustment is applied.

BluHaptics

BluHaptics' software seeks to transition subsea robotics from manual to augmented and automated control. It leverages parallel processing, machine learning and force feedback. Its software is designed to make manipulators and ROVs more intuitive and easy to operate, reducing cognitive stress on pilots and while providing a more intuitive and adaptive interface for pilots. BluHaptics' first software provides a plug and play game pad control system for the Schilling T-4 manipulator.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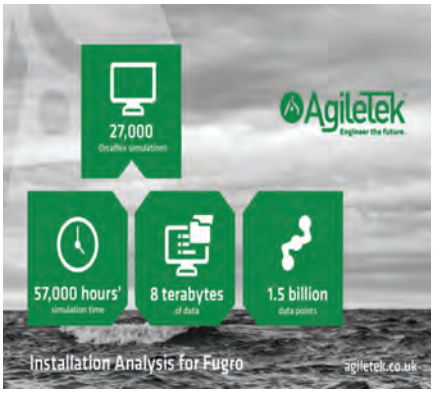

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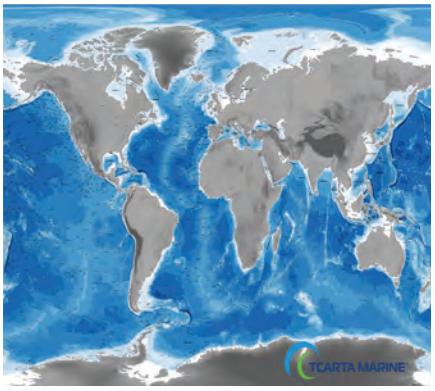
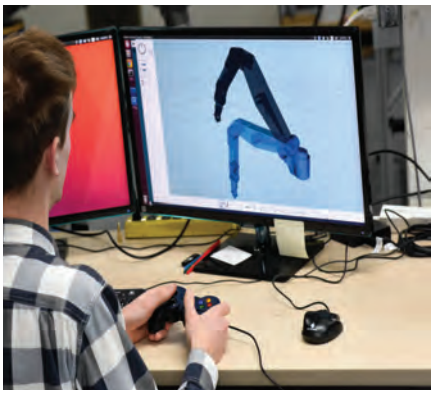


TCarta Marine


BluHaptics

New Products

New 4K UHD Subsea Camera

Sidus Solutions' new subsea camera, the SS490, is a 4K UHD camera that provides superior video image quality at four times the resolution of 1080 full HD images. The camera uses of HDR (high dynamic range) and features 20x zoom and combined optical and digital zoom of 144x. The camera features fully integrated automatic image processing that corrects distortion, shading and chromatic aberration, and it has adaptive noise reduction and visibility enhancement. Constructed with titanium, stainless steel or aluminum housings paired with sapphire or acrylic windows, the SS490 is rated for operating depths of 6,000 m or 3,000 m.

www.sidus-solutions.com

Sidus Solutions

Sidus Solutions

OSIL Launches 3 Axis Accelerometer

Ocean Scientific International Ltd (OSIL) has released a new accessory for its Giant Piston Corer, an accelerometer, which will aid operators with deployments. The accelerometer can calculate the attitude of the corer head on penetration of the corer into the seabed, and the penetration rate of the barrel string, which will assist operators with multiple deployments in the same location by ensuring optimal deployment conditions and sample recovery. The accelerometer is housed in a hard anodized aluminum canister that is rated to full ocean depth.

www.osil.com

OSIL

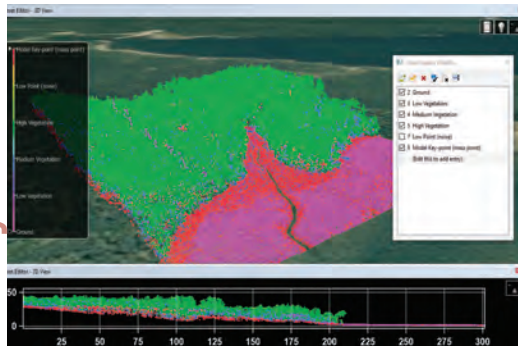
OSIL

Teledyne CARIS Bathy DataBASE

Teledyne CARIS has updated its Bathy DataBASE (BDB) software; version 4.4 addresses feature generalization and automation of product generation for chart compilation, as well as the increasing emphasis on bathymetric Lidar surveys. A collection of new techniques for generalizing bathymetry in chart compilation workflows can be found in BASE Editor. Point suppression and smoothing techniques help reduce the manual work associated with turning survey data into chart ready vector features. New Lidar point cloud editing tools allow for visual inspection, elimination of outliers and point reclassification to be performed at the same time, with one tool. BDB 4.4 also offers improved automation for S-102 and bENC overlays through the inclusion of new sample process models.

www.teledynecaris.com

Teledyne CARIS



Teledyne CARIS

New PAR Measurement Logger

Precision Measurement Engineering has launched the new miniPAR Logger that logs photosynthetically active radiation (PAR), water temperature and tilt measurements. The completely submersible logger measures the amount of diffused sunlight through water, which can be beneficial for understanding nutrient loading, photosynthesis and algal blooms in natural waters up to 100 meters deep.

www.pme.com

Precision Measurement

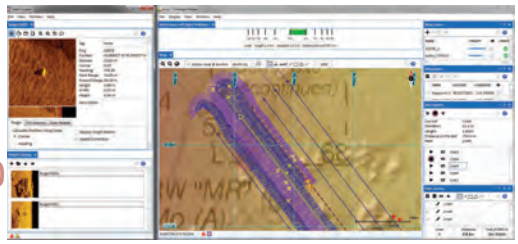
Precision Measurement Engineering

EdgeTech Upgrades Sonar Software

EdgeTech has released a new version of its Discover sonar software, featuring a new software coverage mapper module with advanced navigation features, as well as a new target logger module that simplifies the analysis and measurement of targets of interest. The new software comes with all of the manufacturer's new side scan sonar systems.

www.edgetech.com

EdgeTech



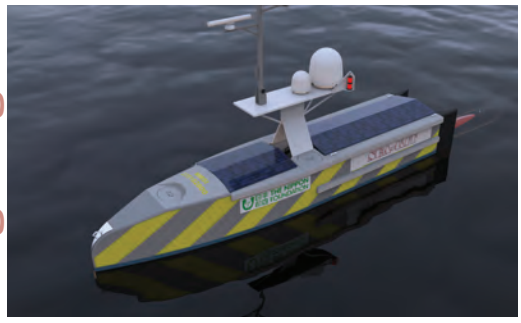
EdgeTech

Kongsberg USV Control System

Kongsberg's new autonomous surface vehicle control system K-MATE, is to be integrated with SEA-KIT, a new class of maritime autonomous surface vessel being built by U.K. manufacturer Hushcraft and operated by SEA-KIT International. K-MATE provides adaptive waypoint following for survey and AUV operations while accepting sensor data for scene analysis and collision avoidance.

www.km.kongsberg.com

Kongsberg



Kongsberg

New Submersible GPS Receiver

A new, robust submersible GPS receiver with integrated L1 + L2 antenna has been launched for the marine survey market. The MiniPod 101G from Modulus Technology Ltd is a lightweight yet rugged product providing streamer head and tail positioning, source positioning for 3D UHR seismic operations and is suited for the positioning of subsea excavation vehicles, or towed sensors such as magnetometers, that operate in shallow waters.

www.modulustechnology.com

Modulus Technology

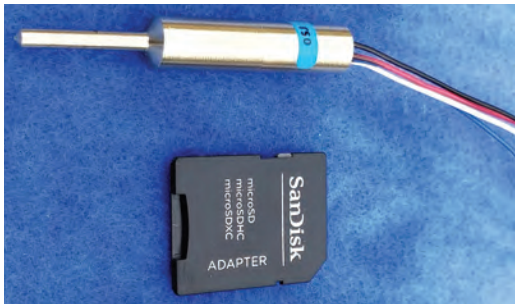
Modulus Technology

New OEM Temperature Sensors

Soundnine Inc. (S9) has launched new OEM Digital Temperature Sensors for integration on underwater instrumentation, drifting buoys, ROVs, AUVs or industrial and laboratory applications. Two mechanical configurations are offered: a screw-in type having 7/16-20 threads commonly used on underwater bulkhead connectors, or plain shank version. The screw-in type has an optional screw-on probe guard. Both are available with wire leads or solder connections.

www.soundnine.com

S9



S9

New Oilfield Comms

Moog Focal has introduced the Quad Serial Server (QSS) module, which combines a 4-channel serial server with integrated 3-port Ethernet switch on a single 3U Eurocard to seamlessly integrate serial interface sensors with modern Ethernet-based control systems. It also enables transmission of Ethernet data over legacy serial telemetry links.

www.moog.com

Moog

Moog

People & Companies


Well-Safe Solutions

Patterson


Xodus Group

Salardi


The Chatty Scientist

Coley

New Decommissioning Player

A new entrant to North Sea decommissioning, Well-Safe Solutions was established by a group of oil industry stalwarts Alasdair Locke, Mark Patterson and Paul Warwick, setting out to provide a new approach to the safe and cost-efficient decommissioning of subsea wells. The new start company, which aims to attract $260 million in investment and create 400 new jobs, will offer a specialist well abandonment service.

Aquabotix Names Curley CDO

UUV Aquabotix Ltd has appointed Ted Curley to the position of Chief Development Officer (CDO) of its U.S. subsidiary, Aquabotix Technology Corporation. Curley will be based in the Massachusetts office and his duties include overseeing all facets of the sales and business development functions.

Curley has more than 25 years sales experience. Most recently Curley was Director of Sales - Vehicles at Teledyne Marine, a division of Teledyne Technologies, Inc.

Salardi to Lead Xodus' Decom

Xodus Group appointed Enrico Salardi as its decommissioning director to lead the company's 'decom division' which was formed in 2015.

Salardi brings to the role more than 20 years' experience in the management of oil and gas assets, joining Xodus from operator Quadrant Energy where he was senior project manager for a number of decommissioning programs in Australia.

Meet The Chatty Scientist

The new online science communication platform, called The Chatty Scientist, offers interactive resources and modern, flexible training that helps scientists discover the tools to best communicate their research, increase exposure and connect with audiences around the world.

The Chatty Scientist is the brainchild of the platform's founder and CEO, Kira Coley, a contributing writer to *Marine Technology Reporter,* freelance science writer and lecturer in science communication at the University of Portsmouth, U.K.

Coley said, "The training options available these days are too limited – not everyone wants to learn everything there is to know about science communication in one go. And, who has the time? Trainers need to rethink how we can best work with scientists so they can get access to these skills in the easiest and most effective way possible."

With this in mind, The Chatty Scientist offers tailored workshops for on-site coaching, along with a growing range of online resources including blogs, expert interviews, videos and podcasts – all geared to help scientists better share their research in a range of formats, including social media.

New Hires Join Kraken Robotik

Kraken Sonar Inc. subsidiary Kraken Robotik GmbH has added several new members to its team: Dr. Jan Albiez, Director of Engineering; Dr. Sylvain Joyeux, Senior Software Scientist; and Patrick Paranhos, Director, Business Development.

- **Dr. Jan Albiez –** Director of Engineering: After being employed for six years as researcher in robotics at FZI in Karlsruhe, Germany, Albiez received his PhD from the University of Karlsruhe in 2007 for his work on biologically inspired walking machines.
- **Dr. Sylvain Joyeux –** Senior Software Scientist: Since receiving his PhD in 2007, Joyeux has been working on software frameworks to enable long-term autonomy in robotic systems. Until 2014 he was part of DFKI in Germany, where he managed autonomy-related projects and later led DFKI's Autonomy team.
- **Patrick Paranhos –** Director, Business Development: Paranhos


Kraken

Dr. Jan Albiez


Kraken

Dr. Sylvain Joyeux


Kraken

Patrick Paranhos

obtained his MSc in Robotics in 2009 from PUC University in Rio de Janeiro, Brazil where he developed probabilistic localization algorithms for a Petrobras robotic system. In 2010, he started at DFKI and was involved in various robotics projects.

Boskalis Acquires Gardline

Netherlands based Royal Boskalis Westminster N.V. has acquired all shares of the U.K. based Gardline Group, a firm specializing in marine geophysical surveys, offshore geotechnical services and environmental surveys. The consideration paid including assumed debt amounts to $51.4 million.

Wilson Joins QPS Sales Team

Matthew J. Wilson joins QPS-US Inc in a marketing and sales position. He comes from NOAA Office of Coast Survey, Atlantic Hydrographic Branch, Norfolk, Va. where he served as a Physical Scientist since 2008. Wilson received a M.B.A. from Pennsylvania State University, graduating with Beta Gamma Sigma honors. He has a M.S. in Ocean Mapping from University of New Hampshire.

Barnum Joins InterAct PMTI

InterAct, an Acteon company, announced that Harry Barnhum, P.G., has joined its team as a Principal Consultant and Regulatory Manager. A licensed professional geologist, Barnum has over 30 years of experience in the oil and gas industry. He has managed all aspects of oil field development, including reservoir analysis, drilling and facility optimization, waterflood and steamflood injection program design, property valuation, regulatory and safety compliance, training, mapping and field engineering.

OPT Opens in Houston

Ocean Power Technologies, Inc. (OPT) established a presence in Houston to more effectively support the company's oil and gas business development activities. The company's daily business development activities in Houston will be managed by OPT's new Director of Global Applications, David Marchetti, who work with customers to understand their challenges and develop unique solutions which integrate the OPT PowerBuoy to support customer subsea remote offshore operations from concept through deployment and beyond.

OPT's PB3 PowerBuoy uses ocean waves to provide clean, reliable and persistent electric power and real-time communications for remote offshore applications.

SMD Expands Servicing Operations

Remotely operated vehicles (ROV) manufacturer Soil Machine Dynamics (SMD) said it is relocating its servicing operations to the Port of Tyne's Tyne Dock estate in South Shields, U.K.

The Tyneside based manufacturing company's head office and heavy production facility will remain in Wallsend and SMD will continue to manufacture ROVs at the Tyne Tunnel Trading Estate in North Shields. Servicing, maintenance and training operations will transfer to the new facility at the Port of Tyne.

The firm will occupy a 23,000 sq. ft. unit at Tyne Dock, which has been modified to offer bespoke accommodation for SMD. Inside, the company will carry out repairs and upgrades and will offer training via state-of-the-art simulation technology designed to mimic sea conditions. With an eaves height of up to 8.1 meters, SMD has space for large-scale equipment and benefits from a large, secure storage yard, dedicated parking and high-speed fiber optic data lines to ensure it can stay in constant communication with clients across

J2 Subsea, Moog Ink Deal

Aberdeen based J2 Subsea, an ROV and survey tools rental and sale specialist in

People & Companies


QPS

Wilson


InterAct

Barnum

Ocean Power Technologies

OPT

subsea services group Acteon, secured a new distribution agreement with Moog, a designer and manufacturer of control systems and components.

ABB Software Supports Ocean Research

ABB said it is providing the shipboard systems and systems expertise that will support the research voyages undertaken by 'By the Ocean we Unite', a charitable organization whose mission is to highlight the damage done by the millions of tons of plastics that end up in the world's oceans every year.

The group has installed a state of the art Marine Advisory System including SPOS Onboard weather routing software from MeteoGroup, on the sailing yacht Fantastiko to help crew route-plan and monitor weather conditions on a research voyage in waters off Rotterdam, the South of England, the Channel Islands, France and Belgium during August.

MetOcean Telematics Wins Canada Satcom Contract

MetOcean Telematics was awarded a multi-year contract to provide global satellite communications to the Canadian Government, exclusively through the Iridium network.

The agreement will feature MetOcean Telematics hardware products and services, deployed for use by more than 150 Canadian Government agencies. The Iridium network satellite constellation offers 100 percent global coverage, including the polar regions, such as the remote Arctic territory of northern Canada.

M2, Harvey Gulf Partner

Remotely operated vehicle (ROV) services provider M2 Subsea formed an alliance with Harvey Gulf Marine International to provide subsea ROV services in the Gulf of Mexico.

The alliance will see M2 Subsea's ROVs used on board Harvey Gulf's DP2 survey support vessel, the Harvey Bronco. The offshore supply ship will focus on the survey and inspection market and will be equipped with M2 Subsea's 150HP Triton XLX34 ROV system.

Offshore Drone Survey

DNV GL said its surveyors have carried the group's first offshore drone survey on the semisubmersible vessel Safe Scandinavia in the North Sea. The 25,383 GT tender support vessel (TSV) Safe Scandinavia is owned and operated by Prosafe, supporting Statoil's drilling operations off the coast of Norway. Using camera-equipped drones, DNV GL's drone pilots checked the TSV's fairleads and their connection with the vessel's two columns as part of the intermediate survey.

DNV GL has built a network of trained drone pilots based in Gdynia, Piraeus, Singapore, Houston and Shanghai. This allows drone survey inspections to be offered from any of these hubs. At the same time, DNV GL is developing guidelines and updating our rule set to reflect the use of remote inspection techniques.

Saudi Aramco Buys AUV

Saudi Aramco acquired an autonomous underwater vehicle from Teledyne Gavia. The Gavia Offshore Surveyor AUV system is expected to enhance Saudi Aramco's agility in meeting high demands for hydrographic survey services through the company's in-house survey operations. The Gavia system will be utilized predominantly for debris survey and pipeline inspection in the Arabian Gulf, with a potential service extension for other type of surveys in water depths up to 1,000m in the Red Sea region.

The Gavia AUV is an autonomous, modular sensor platform that is field configurable by means of a unique twist lock system. Operators can rapidly change or add sensors, navigation, or battery modules between missions, making the Gavia AUV a flexible and cost effective asset. The Gavia is a low logistics system designed to be operated from vessels of opportunity and has the


SMD

SMD


M2 Subsea

Arnold


DNV GL

Drone survey offshore.

greatest depth rating of any vehicle in its class. Since the initial sale of Gavia AUVs to the oil and gas sector in 2007, Gavia AUVs have been operated globally by service providers for a variety of commercial oil and gas surveys with proven industry accepted results.

Vryhof Expands

Vryhof, a provider of anchoring and mooring solutions, expands its global footprint with its companies Deep Sea Mooring (DSM) opening a new office in Aberdeen and Vryhof Anchors appointing Singapore-based Franklin Offshore as its exclusive representative for selling Vryhof solutions in a number of Asia

Containerized Diving Systems

Submarine Manufacturing and Products Ltd. (SMP) announce that it had won a contract with the U.K. Ministry of Defense (MoD) to design and manufacture two 20 ft. DNV Containerized Diving Systems (CDS).
SMP was selected through a tender process to design, manufacture and supply two identical 20 ft. DNV CDS. SMP said these systems will be based on a past proven design created by SMP.

CCC' New Mapping Capability

Kongsberg Maritime said the Canadian Coast Guard has chosen its high resolution EM 712 multibeam echo sounders for the medium icebreakers CCGS Pierre Radisson and the CCGS Des Groseilliers.
The retractable design of the new EM 712 echo sounder systems optimizes performance of the sounder when deployed and protects it when the vessel is breaking ice.


Vryhof

Tafazzoly

ABB

BTOWU vessel Fantastiko.

Preview

Oceans 2017

What: ..... Oceans 2017
When: ..... Sept. 18-21, 2017
Where: ..... Anchorage, Alaska
www.oceans17mtsieeeanchorage.org

The Photo..... Image Credit: © Rocky Grimes / Adobe Stock

Every autumn the Marine Technology Society and the IEEE Oceanic Engineering Society cosponsor a joint annual conference and exhibition that focuses on advances in marine science, engineering, technology and policy. This year's running, Oceans 2017, is set to take place September 18-21, 2017 in Alaska at the Dena'ina Convention Center located in downtown Anchorage.

According to its organizers, the annual event typically draws some 2,000 attendees from industry, academia and government; more than 500 professionally reviewed technical papers and 100-plus exhibitors showcasing some of the latest products, services and technological advancements; as well as a wide spectrum of plenary sessions, tutorials, workshops, demonstrations, professional field trips, networking opportunities and more.

The theme for this year's conference is "Our Harsh and Fragile Ocean," or "How to protect the Fragile from the Harsh with application of modern technology and traditional knowledge working together," bringing consideration of issues such as climate change, diminishing arctic ice pack, ocean acidification, increased vessel traffic in arctic waters, energy extraction and more.

Oceans 2017 Exhibitors List

Company	Booth	Website
Aanderaa - Xylem	309, 311	www.xyleminc.com
Alaska Ocean Observing System	603	www.aoos.org
ALSEAMAR	407	www.alseamar-alcen.com
American Marine International	606	amarinecorp.com
AML Oceanographic Ltd	303	www.AMLoceanographic.com
APM Hexseal	518	www.apmhexseal.com
Arctic Rays LLC	520	www.arcticrays.com
ASL Environmental Sciences, Inc.	819	www.aslenv.com
Atlantic Canada/ Nova Scotia Business	622, 623	www.novascotiabusiness.com
Campbell Scientific	414	www.campbellsci.com
Center for Integrated Underwater Observation of Technology	806	unac.iis.u-tokyo.ac.jp
Consortium for Ocean Leadership	722	www.oceanleadership.org
DeepWater Buoyancy, Inc.	716	DeepWaterBuoyancy.com
EdgeTech	517	www.edgetech.com
Energy Sales, Inc.	702	www.energy-sales.com
General Dynamics Mission Syst.	304, 306	www.gdmissionsystems.com
General Titanium inc	416	www.biam.com
Geometrics	811	www.geometrics.com
GeoSpectrum Technologies Inc.	621	geospectrum.ca/
Glenair, Inc.	715, 717	www.glenair.com
Global Dynamix	317	www.gdynx.com
Harris Acoustic Sensors	402	www.harris.com
Imagenex Technology Corp.	816	www.imagenex.com
International Ocean Systems	310	www.intoceansys.co.uk
Japan Agency for Marine-Earth S&T	808	www.jamstec.go.jp
JFE Advantech Co., Ltd.	803	www.jfe-advantech.co.jp
Knudsen Engineering	902	www.knudseneng.com
Koken Boring Machine Co., Ltd.	805	www.koken-boring.co.jp/
Kongsberg	910	www.km.kongsberg.com
Lockheed Martin	826	www.lockheedmartin.com
Marine Magnetics	519	www.marinemagnetics.com
Marine Sonic Technology	521	www.Marinesonic.com
Marine Technology Reporter	706	www.marinetechnologynews.com
MATE	406	www.marinetech.org
MetOcean Telematics	405	www.metocean.com
MTS/OES Societies	502, 504, 506	www.mtsociety.org, www.oceanicengineering.org
National Oceanographic Partnership Prog.	320	www.nopp.org
NeXOS Project	308	www.nexosproject.eu
NOAA	815	www.noaa.gov
Nortek	302	www.nortekgroup.com
Ocean Aero Inc	809	www.oceanaero.us
Ocean Networks Canada	821	www.oceannetworks.ca
Ocean Observatories Initiative	724	www.oceanobservatories.org
OCEANS 18 Charleston	503	www.oceans18mtsieeecharleston.org
OCEANS 18 Kobe	505	www.oceans18mtsieeekobe.org/
OCEANS 19 Seattle	507	www.oceans19 mtsieeeseattle.org
OceanWorks International	823	www.oceanworks.com
Okeanus Science & Technology LLC	703	www.okeanus.com
Orcina / Heron Offshore	727	www.heronoffshore.com
Port & Airport Research Institute	802	www.pari.go.jp
PPR Alaska, LLC	1002, 1004, 903, 905	www.ppralaska.com
Pro-Oceanus Systems	618	www.pro-oceanus.com
RBR Ltd.	314	www.rbr-global.com
ROMOR	619	www.romor.ca
Saab North America, Inc.	704	www.saab.com
Saildrone, Inc.	921, 923	www.saildrone.com
SBG Systems	516	www.sbg-systems.com
Sea Sciences, Inc	315	www.seasciences.com
Sea-Bird Scientific	709, 711	www.seabird.com
Seafloor Systems, Inc.	814	www.seafloorsystems.com
SeaView Systems, Inc.	914	www.seaviewsystems.com
Soundnine, Inc.	419	www.soundnine.com
South Bay Cable	720	www.southbaycable.com
SubC Imaging	617	www.subcimaging.com
SUBSEA 20/20, Inc.	316, 318	www.subsea2020.com
Subsea Technologies, Inc.	305	www.subseatechnologies.com
SULIS Subsea Corporation	620	www.sulissubsea.com
Tachyonish Holdings Co., Ltd	807	www.tachyonish.com
Teledyne Marine	810	www.teledynemarine.com
TerraSond Limited	607	www.terrasond.com
The Tsurumi-Seiki Co., Ltd.	804	www.tsk-jp.com
Trelleborg Applied Technologies	705	www.trelleborg.com
Turner Designs	417	www.turnerdesigns.com
U.S. IOOS	817	ioos.noaa.gov
U.S. Bureau of Ocean Energy Mgmt	408, 410	www.boem.gov
Unit Process Company	602	www.unitprocess.com
University of Alaska Anchorage	403	www.uaa.alaska.edu
Valeport Ltd.	324	www.valeport.co.uk
VideoRay	404	www.videoray.com
Xeos Technologies, Inc.	616	www.xeostech.com

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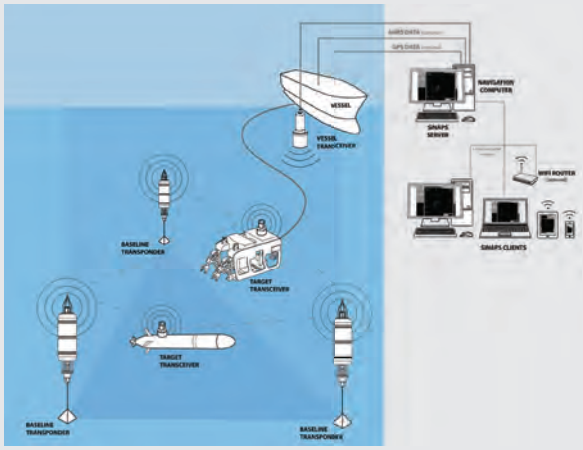

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