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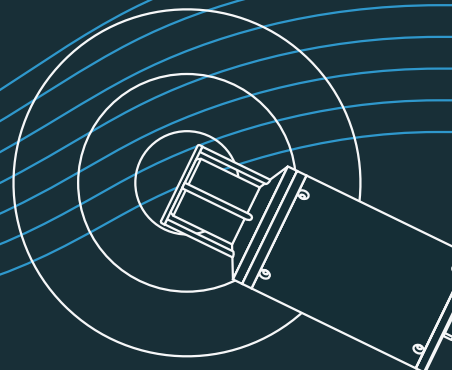
UNDERSEA DEFENSE ANTISUBMARINE WARFARE

FEATURING:

LUSV Concept for ASW

Connectors for Undersea Networks

ROVs for Defense



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- Delivering data in most adverse conditions: underwater acoustic modems with advanced communication technology and networking
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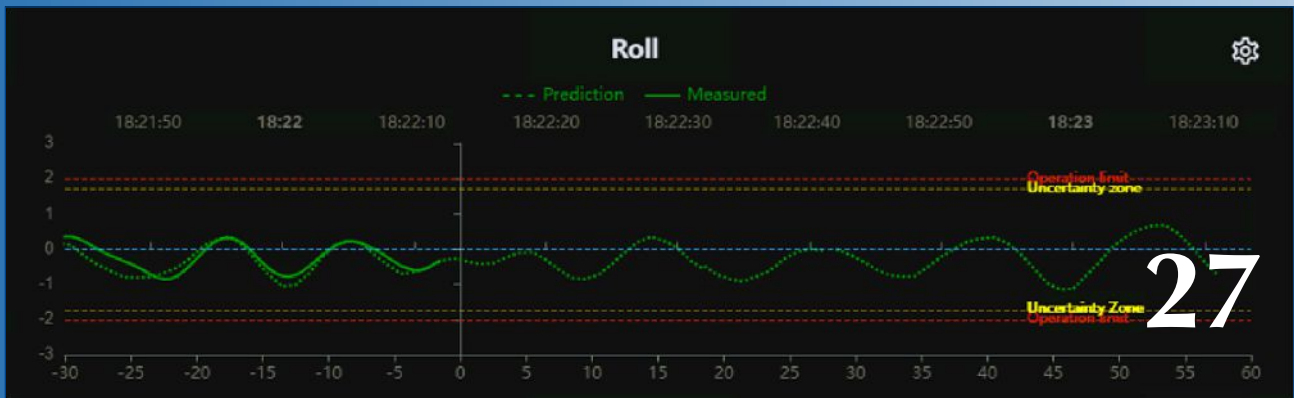
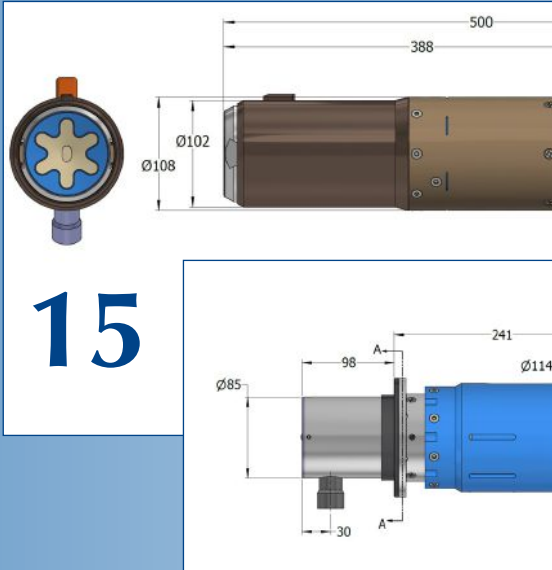


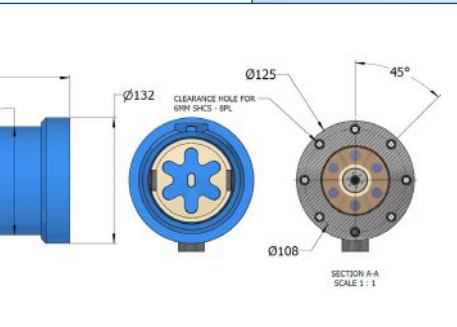
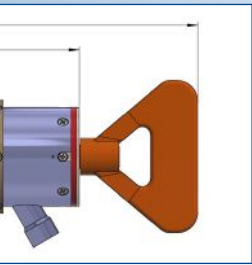
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COVER IMAGE

U.S. Navy explosive ordnance disposal (EOD) technicians and members of the Japan Maritime Self-Defense Force EOD conduct diving operations at Naval Base Guam, April 2024. (Credit: U.S. Navy, Ivan Skvaril)

NEXT MONTH

ROVs for marine biopharmaceutical research ... Monitoring environmental effects of deep-sea mining ... Cables for infrastructure inspection ... HAUVs for mapping ... Dive explorer Richie Kohler.

Editor's Note: A reader pointed out that the October 2024 issue's Editorial had a misleading statement. Citing NOAA, he clarified that the ocean generates half of Earth's oxygen, but marine life consumes about the same amount.

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)) JDP for 3D Vessel Model Design, Approval. Bureau Veritas (BV) and Mitsubishi Shipbuilding (MSB), part of Mitsubishi Heavy Industries (MHI) Group, have completed a joint development project (JDP) to implement 3D model-based approvals. This collaboration marks Mitsubishi Shipbuilding's first application of a 3D classification approach, streamlining its design processes through digital innovation. The project has significantly enhanced the design approval process by replacing traditional 2D drawings with a detailed 3D digital mock-up from the designers. This new approach reduces the need for multiple 2D conversions, lightening the shipyard workload and accelerating the design process while improving accuracy. The 3D model also functions as a dynamic database for calculations, helping to minimize errors and inconsistencies across design revisions. The project applies to MSB's complex vessel designs and their unique challenges, underscoring the importance of 3D model-based classification technology. In the initial phase, MSB transmitted 3D models to BV using the Open Class eXchange (OCX) format. BV reviewed these models and provided feedback through its collaborative platform, Veristar Project Management (VPM), with comments directly linked to the 3D model. This setup streamlines communication and the review processes. The solution includes a web-based platform for real-time exchange of 3D classification packages and comments, with detailed model analysis, and is compatible with various operating systems and functional offline. VPM enhances this process with secure access, property rights management and efficient comment handling, ensuring a structured review from submission to final approval.

)) Adventurer to Deploy Argo Float on Solo Expedition. A British adventurer sailing solo around the world, after cycling and flying the Earth's circumference, has partnered with the U.K.'s National Oceanography Centre (NOC) to add ocean science to his latest one-man mission. NOC Ambassador James Ketchell will deploy a special ocean profiling instrument on his 30,000 nautical mi. solo journey (<https://jamesketchell.net/about-the-challenge>). The Argo float can autonomously take critical measurements, such as temperature and salinity, down to 2,000-m water depth (*Sea Technology*, October 2024). Ketchell's mission, which launched in September from Gosport, U.K., on his Class 40 yacht, comes as the global fleet of Argo floats reaches a milestone of 3 million profiles, amounting to billions of individual measurements. The data provides scientists globally with a unique insight into what is happening beneath the sea surface, which can impact everything from global weather trends to the health of marine ecosystems. There are more than 3,600 Argo floats worldwide, forming the international collaborative Argo program, to which NOC contributes. Argo floats gather essential real-time data to improve our understanding of the ocean's role in the Earth's climate and to make improved estimates of how it will change in the future. Ketchell's voyage is split into legs, stopping in Lanzarote, Spain; Cape Town, South Africa; Melbourne, Australia; Punta Del Este, Uruguay; Antigua; and New York, before arriving back into Gosport. Ketchell will deploy his Argo float, measuring around 1.5 m long, after a stop in Cape Town. On his journey, Ketchell will also support ocean education through livestreaming and visits to schools at the ports on his itinerary.

)) Milestone for CCS. DNV has certified the first CO₂ storage site for Project Greensand in Denmark, marking a key milestone in carbon capture and storage (CCS). Building on prior certifications issued in June 2023, DNV has granted the Certificate of Conformity – Site Endorsement and Storage Site, confirming that the project operator has developed plans for the safe and effective geological storage of CO₂ in compliance with ISO 27914. Denmark's first offshore CO₂ storage site, Project Greensand, is a collaboration of 23 partners to showcase the potential for safely storing CO₂ permanently to mitigate climate change. As worldwide efforts to meet climate targets intensify, CCS technologies are expected to be crucial in reducing CO₂ emissions. Independent assurance from organizations such as DNV will ensure large-scale CCS projects meet stringent safety and performance standards, building public and investor trust. DNV has supported Project Greensand throughout its development. By 2025/2026, Project Greensand aims to store up to 400,000 tonnes of CO₂ annually, with potential expansion to 3 million tonnes by 2030.

)) New Research on Potential Adhesives from Oysters. Freshwater oysters produce an adhesive with potential to develop more environmentally friendly glues that have applications from dental care to construction and shipping. An international research team has used the Canadian Light Source at the University of Saskatchewan to determine the composition of the unique adhesive. Thriving in African rivers and lakes, *Etheria elliptica* oysters produce a special material that helps them stick to wood or other oysters, creating complex underwater reefs. Never studied before, this oyster glue has characteristics rarely found in similar organisms. It's made of a mineral called aragonite that the oyster arranges so that it is soft on the outside and progressively harder on the inside. The oyster glue is so sticky because it combines the aragonite with special proteins that the oyster produces. This could lead to better synthetic "green" glues that could be used, for example, to bind dental implants, replace glues currently used in the packaging industry with biodegradable alternatives, and build structures underwater. This research may also prove critical for the ecological conservation of *Etheria elliptica* oysters, helping to preserve habitats that ensure the oysters' survival in a warming climate and informing local populations about sustainable oyster harvesting. **ST**

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Technology Roadmap For Autonomous Warship

Transformation in the maritime sector driven by growth in the blue economy, the energy transition and the shift to more sustainable shipping is underpinned by digitization and other advances in technology, with over 30 billion Internet of Things technologies expected to be operational by 2025. Concurrently, the risk landscape continues to evolve with new threats to shipping and critical infrastructure, as well as demographic forces affecting availability of skilled mariners. New and emerging technologies present opportunities to tackle these challenges and improve sustainability, efficiency, and safety.

Uncrewed vessels are already proving their value in completing dull, dirty and dangerous tasks, such as mine countermeasures, surveillance and survey. However, these are generally small vessels (< 24 m) and therefore limited in operating areas, payload and persistence, with not all solutions being able to scale up to meet the capability of a larger ship. To address this gap, BMT is developing a Large Uncrewed Surface Vessel (LUSV) concept that can utilize the benefits of autonomy to add mass to a fleet at lower cost.

The core challenge for command and control is ensuring that the system can be reliably operated for months at a time, maintaining navigational situational awareness with minimal human interaction. Autonomous navigation software is increasingly capable in small vessels, requiring thorough testing and validation to assure performance and create confidence for use in larger ships. A key aspect is reliable and secure high bandwidth beyond line-of-sight communications. Low Earth orbit satellites have been a game changer to enable more robust communications with increasing levels of bandwidth and redundancy, but cybersecurity remains a concern. New data processing techniques and encryption algorithms are being developed to strengthen the principles of a secure system of systems.

Long-endurance operations necessitate new strategies for ensuring vessel and mission resilience. Fire is a common hazard, and automated firefighting systems are being developed for marinization. Damage repair needs a more novel solution set. Items such as airbags can reduce the impact of lost compartments, while new and developing self-healing materials could provide an even greater response.

Force protection is another risk usually mitigated by human intervention; non-lethal denial systems are being developed for this purpose. The wider design of such a vessel will also impact the protection needed, such as how easy it is to board and damage systems or affect operations. Maintenance strategy must also be considered, and the best solution will likely be a mixture of top-side design and supporting technologies.

To future-proof the vessel, an all-electric propulsion solution is proposed to reduce mechanical maintenance and allow for changes in the power generation plant as technology develops. Using modular prime movers simplifies the maintenance process in port with hot-swappable key equipment; this has an added bonus of enabling greater flexibility for future fuel selection.

One challenge with the incorporation of these elements into a ship design is the need to embed new and unfamiliar practices into the way we maintain a ship, and this applies to all of the technologies mentioned here. From training remote operators to holistic organizational culture, the evolution of behavior, not just of design and technology, is required to ensure effective vessel design and performance, so that these pioneering technologies can help this LUSV concept bring transformational benefits to the maritime space. **ST**

SEA TECHNOLOGY® 2024

JANUARY

Annual Review & Forecast

****EUROMARITIME 2024**, January 30-February 1, Marseille, France

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

****Oceanology International 2024**, March 12-14, ExCel, London, U.K.

MARCH

Electronic Charting/Vessel Management/ Ports & Harbors/Dredging/Homeland Security

****UDT 2024**, April 9-11, ExCel, London, U.K.

****OCEANS 2024 Singapore**, April 14-18, Singapore

****XPONENTIAL 2024**, April 22-25, San Diego, CA

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

****Offshore Technology Conference**, May 6-9, Houston, TX

MAY

Communications, Telemetry, Data Processing

JUNE

Seafloor Mapping/Sonar Systems/Vessels

****Sea Technology supports these shows**

BONUS INFORMATION

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Deck Gear, Cable, Connectors, Power Systems & Salvage

****IMAGE 2024**, August 25-30, Houston, TX

AUGUST

Ocean Resources Development & Coastal Zone Management

****OCEANS 2024 Halifax**, September 23-26, Halifax, Canada

SEPTEMBER

Geophysical Exploration/Seafloor Engineering

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

****EURONAVAL 2024**, November 4-7, Paris, France

****CLEAN GULF**, November 18-20, San Antonio, TX

****MAST Australia 2024**, November 19-21, Adelaide, Australia

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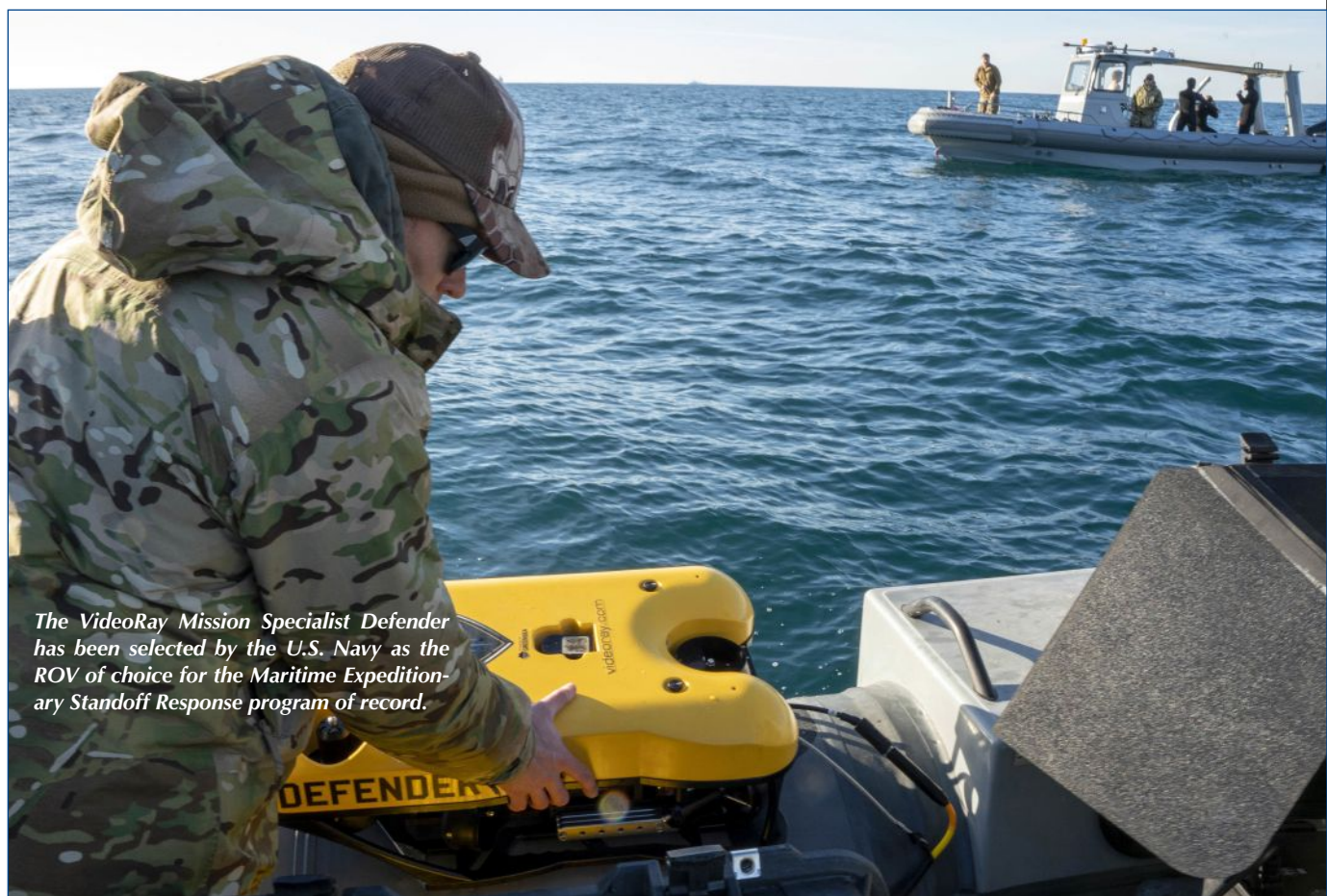
The Expanding Role of ROV Technology

By Chris Gibson

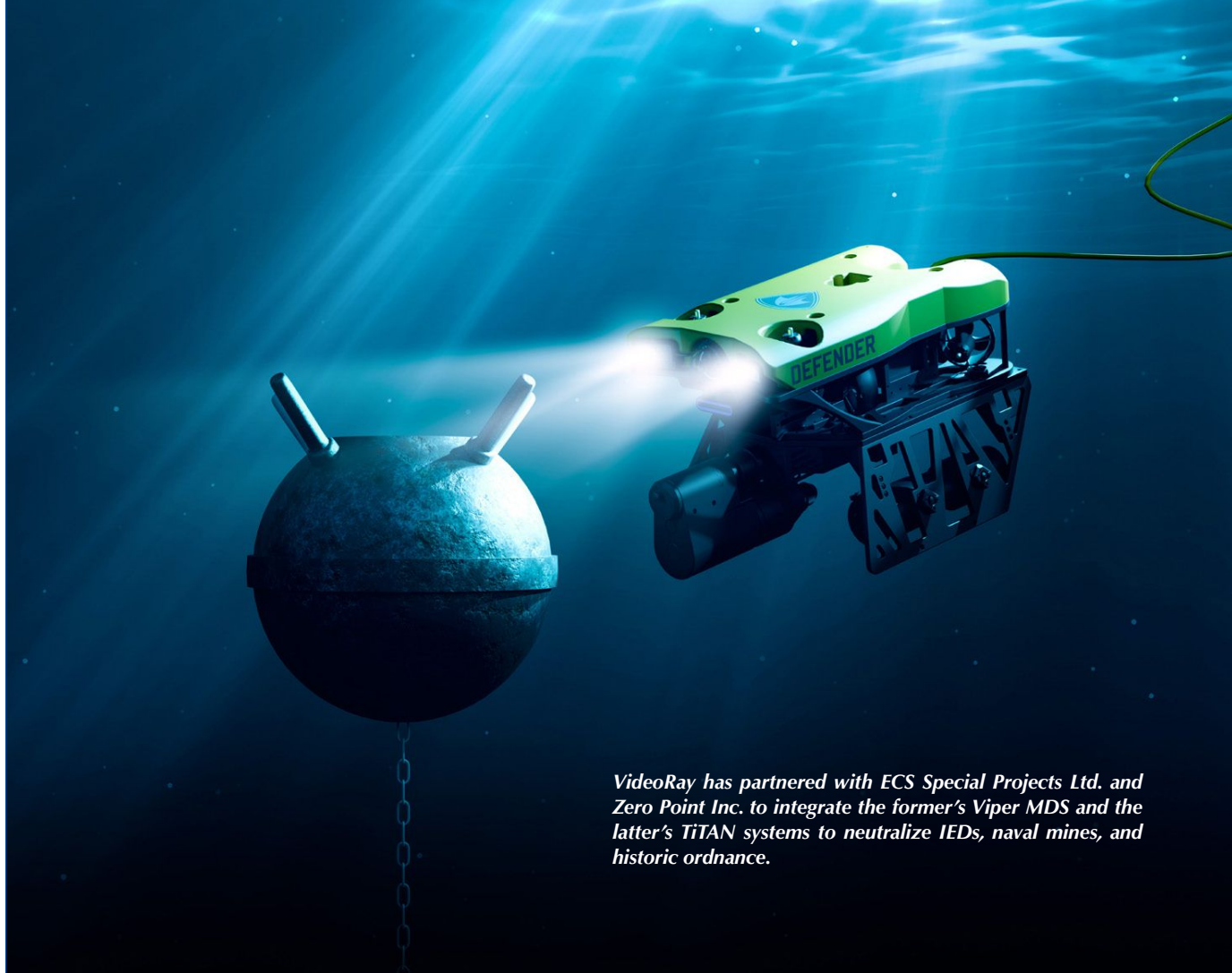
Undersea robots play an increasingly crucial role in modern defense applications by improving operational efficiency, accelerating repetitive tasks, increasing safe stand-off distances, protecting divers and ensuring mission success.

ROVs, a category of undersea vehicle, are vital for underwater inspection, reconnaissance, monitoring, mine

detection and neutralization tasks. These submersible robots support intelligence-gathering missions by providing real-time data and imagery from environments that are otherwise difficult or dangerous to access. Such capabilities are essential for enhancing situational awareness and decision making in complex maritime and coastal environments, such as ports and harbors. Over-



The VideoRay Mission Specialist Defender has been selected by the U.S. Navy as the ROV of choice for the Maritime Expeditionary Standoff Response program of record.



VideoRay has partnered with ECS Special Projects Ltd. and Zero Point Inc. to integrate the former's Viper MDS and the latter's TiTAN systems to neutralize IEDs, naval mines, and historic ordnance.

all, the integration of remotely piloted and autonomous undersea vehicles into defense strategies improves operational effectiveness, minimizes risk to personnel, and provides a technological edge in underwater and surface operations.

In support of these missions, VideoRay, founded in 1999 in Pottstown, Pennsylvania, leads innovation and development of ROVs, leveraging more than 25 years of real-world experience and operator feedback to become a key player in the mine warfare and mine countermeasures community. For example, the VideoRay Mission Specialist Defender vehicle was recently selected by the U.S. Navy to serve as the backbone of the Maritime Expeditionary Standoff Response Explosive Ordnance Disposal (EOD) ROV program of record with the PMS 408 program office.

Key defense projects that rely on VideoRay technology include: the Autonomous Maritime Expedition Response Vehicle program to develop autonomous systems for intelligence, surveillance and reconnaissance missions, search and rescue, and environmental monitoring without human intervention; the Low-Observable/No-Collateral Damage Neutralization project to neutralize kinetic threats while avoiding collateral damage and maintaining a low-profile insertion; and the Autonomous Amphibious Response Vehicle program to develop amphibious un-

crewed systems capable of creating permissive wedges for exquisite (a U.S. Department of Defense term indicating "high-cost" and/or "exceptional") and crewed assets by detecting, identifying, and neutralizing kinetic and non-kinetic hazards in very shallow waters, surf zones, and beaches.

In addition to defense programs, VideoRay routinely participates in exercises such as REPMUS (Robotic Experimentation and Prototyping using Maritime Uncrewed Systems) and other NATO activities, as well as the U.S. Navy's Trident Spectre. These programs benefit from the VideoRay Mission Specialist Defender ROV's characteristics of reliability, resilience, modularity and flexibility.

Overview of ROV Technology

ROVs are usually thought of as a tethered box-shaped vehicle with thrusters, cameras, lights and manipulator arms with grippers, piloted manually by an operator at the surface. While initially true, recent technological advancements in processing power, miniaturization and intelligent software have enabled greater autonomy and less reliance on both tethers and human operators to accomplish their mission.

VideoRay currently offers three models under the Mission Specialist modular architecture: the Pro 5, the Defender and the Ally, the newest addition to the fleet.



The Defender is a standard vehicle of navies and commercial outfits worldwide due to its small size, proven reliability, modular flexibility and extensibility, and intuitive controls.

The Mission Specialist Defender represents the most capable of the VideoRay systems, with seven thrusters and more than triple the depth rating of the Pro 5 and Ally at 1,000-m operating depth. The Defender is a standard vehicle of navies and commercial outfits worldwide due to its small size, proven reliability, modular flexibility and extensibility, and intuitive controls.

Defense Applications

MCM. VideoRay's underwater robots are increasingly employed for naval mine detection and neutralization due to their precise positioning capabilities in hazardous environments. These underwater robots are equipped with advanced sonar systems and high-resolution optical cameras to detect and identify submerged mines. Once a potential mine is located, the ROV can maneuver close to it, using its manipulators to deploy neutralization devices or trigger safe detonation methods from a distance. The use of VideoRay's ROVs in this context enhances safety by allowing human operators to remain on the surface while the robot performs dangerous tasks in potentially volatile underwater conditions. This technology significantly improves the efficiency and safety of mine clearance operations.

The Dutch Navy enlists VideoRay underwater robots to assist with MCM and EOD operations to neutralize derelict explosives that are being discovered in their waterways from the First and Second World Wars. The Dutch opted for accessories such as the hull-crawler module, which enables the vehicle to glide along curved ship hulls to ensure there are no explosives, and multi-

beam imaging sonar for clear acoustic imagery in turbid waters.

VideoRay has also partnered with organizations such as ECS Special Projects Ltd. and Zero Point Inc. to integrate the former's Viper MDS and the latter's TiTAN systems to neutralize IEDs (improvised explosive devices), naval mines, and historic ordnance.

Port and Harbor Security. VideoRay's underwater robots also play a crucial role in bolstering security in and around ports and harbors by providing detailed underwater inspection and surveillance capabilities. They are deployed to monitor facility perimeters, offering a comprehensive view of the area and detecting any potential

All Mission Specialist vehicles are comprised of swappable modules that connect to a common communications and power bus, giving them unprecedented flexibility and versatility. The Pro 5 weighs 22 lb., has a depth rating of 300 m, and can be configured with a full suite of sonars, high-resolution cameras, positioning systems and more.

The Ally extends the Pro 5's capabilities with additional power options, larger lift capacity, and new autonomous behaviors for both normal operations and emergency fallback procedures. In addition, due to the modular construction, there is a direct upgrade path to the inspection-class Defender line of vehicles.



ROVs provide critical support for seabed warfare through reconnaissance, data gathering and environmental monitoring.

breaches or suspicious activities. Equipped with high-resolution cameras and sonar, these underwater robots can inspect submerged structures such as docks, piers, and ship hulls for signs of damage, sabotage, or unauthorized modifications. Additionally, their ability to operate in low-visibility conditions and navigate confined spaces makes them invaluable for detecting and investigating suspicious objects or activities that could pose a threat to normal operations. By integrating VideoRay's ROVs into port security operations, authorities enhance their ability to safeguard critical maritime infrastructure and ensure the safety of both shipping lanes and port facilities.

Through the Department of Defense's Irregular Warfare Technical Support Directorate, the VideoRay Defender was selected as the standard observation-class ROV for the U.S. Coast Guard (USCG). The USCG deploys the Defender in order to perform visual inspections and preliminary surveys of infrastructure, objects, and

areas of interest before further intervention.

Earlier this year, the Mission Specialist Ally was used at the site of the Francis Scott Key Bridge in Baltimore, which collapsed when a container ship collided with it. The Ally was deployed to map the submerged wreckage and provide officials and remediation teams with situational awareness in an environment that would have been too dangerous for divers.

Underwater Ship Husbandry. VideoRay's underwater robots have also become essential tools for the maintenance and inspection of naval vessels, significantly enhancing the efficiency, safety and pace of these operations. They are equipped with high-resolution cameras, acoustic sensors and more specialty sensors, such as hull-thickness and chemical sensors to perform detailed hull inspections, detecting cracks, corrosion, biofouling or other structural issues.

Beyond inspection, these underwater robots also facilitate cleaning tasks through the use of specialized tools to remove marine growth, sediment and debris from the hull, which helps maintain optimal vessel performance and fuel efficiency while reducing greenhouse gas emissions by over 20 percent.

Additionally, these vehicles assist in repair tasks by deploying patching materials, performing small-scale fixes, and assisting

in-water divers through safety oversight and tool and equipment carriages, reducing the need for drydocking and helping keep the fleet at sea rather than in port. The use of VideoRay's ROVs ensures that naval force vessels remain in fighting condition while avoiding the risks and costs associated with traditional maintenance methods.

The modular architecture of the VideoRay Mission Specialist system enables users to swap components and configure vehicles for a variety of hull inspection, maintenance, and remediation tasks. In addition, VideoRay Labs is investigating at-sea tactics to provide automated inspection and maintenance tasks while minimizing human supervision.

Seabed Warfare. VideoRay's underwater robots are pivotal tools in seabed warfare, offering critical support through reconnaissance, data gathering and environmental monitoring. The integration of advanced sensors and processes such as optical and acoustic 3D recon-

struction enable detailed mapping of the seabed, uncovering underwater features and potential hazards that can influence strategic military decisions. These ROVs are used to identify and catalog underwater structures, obstacles, and the presence of undesirable equipment or naval mines. They also monitor seabed conditions, such as sediment composition and underwater currents, providing valuable information for planning naval operations and deploying underwater assets. By delivering precise and real-time data, VideoRay's Mission Specialist underwater robots enhance situational awareness and operational planning, giving military forces a strategic edge in navigating and controlling the undersea domain.

Through a partnership with ELWAVE, VideoRay vehicles were equipped to detect local electric field disturbances to enhance navigation, perform sediment analysis (detection of buried objects and strata), and avoid potential obstacles. Similarly, a partnership with Reach Robotics resulted in the development of novel cutting solutions, multi-jointed articulated manipulator arms, and sensitive site exploitation capabilities supporting seabed defense efforts.

Challenges and Future Directions

As capable as these underwater robots are today, our customers, both commercial and government are interested in extending the operational depths of the vehicles; overcoming environmental constraints, such as minimal visibility, currents and biofouling; and further technology

advancements, such as higher accuracy navigation, better fine-motor control and autonomous behaviors.

VideoRay is looking ahead through the launch of VideoRay Labs, which is making strides in mixed-reality telepresence for immersive operator experience, more intuitive control, unsupervised operation, and better and faster 3D perception. In addition, VideoRay Labs has developed a multimodal input system where operators can use voice, gesture, physical controls, and more to operate one or more deployed vehicles in a convenient head-mounted display with an intuitive interface and extensible library of supported devices to ensure maximum interoperability with radios, modems, sensors, and systems.

As the technological pace of warfare accelerates—more distributed, more networked and more robotic—VideoRay and VideoRay Labs technologies enable at-scale command and control, reduce operator task-loading, and provide simpler and faster decision aids to ensure the safety of our fleet and fighters and maintain our control of the battlespace.

You can learn more by visiting VideoRay.com and contacting sales@videoray.com to discuss your application and needs or schedule a demonstration. **ST**

Chris Gibson is the CEO of VideoRay LLC.



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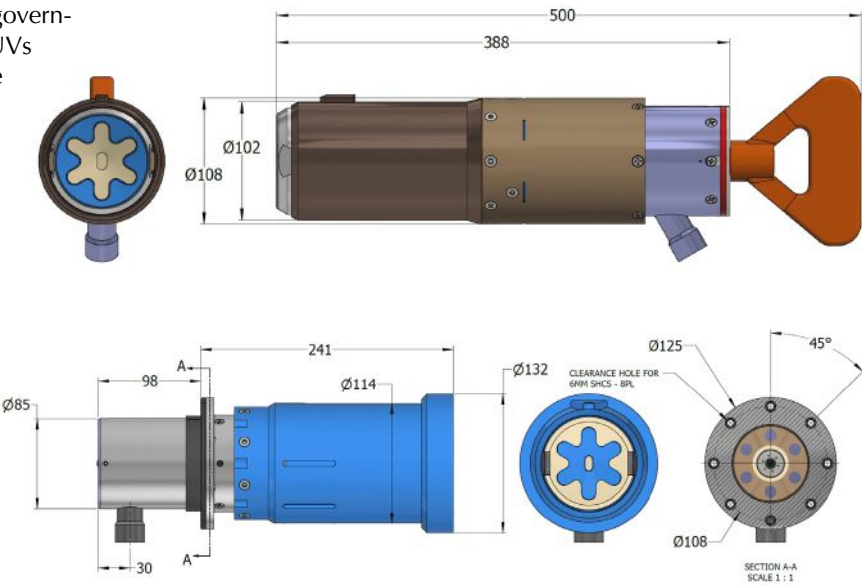
Connectors for Undersea Defense

Wet-Mate Connectors Provide Reliability for ASW Networks

By John Toth • Greg Scull • Don Heinz

Combating enemy submarines grows more complex with new technology. To better detect, track, deter and destroy enemy submarines, the U.S. government has combined sensors and UUVs to create fused anti-submarine warfare (ASW) networks. These networks are processing greater amounts of data and images, requiring equipment that provides greater power levels and processing paths.

A piece of equipment that is often overlooked in ASW networks is the interconnecting system. These connections can be the single point of network failures. Wet-mate connectors (WMCs) can provide flexibility in system design and architecture over the life of a given system. But there is sometimes a lack of trust



DL5500 wet-mate connector: cable end (flying) plug and bulkhead receptacle.

DL5500 Circuit Configurations						
Insert Type	Contact Type	Contacts Per Insert	Optical Capacity	Electrical Voltage	Electrical Current	Contact Availability w/max 6-Inserts per Connector
Electrical	20 Gage	4	NA	1,000 V	5 A	24
Electrical	20 Gage	3	NA	1,000 V	5 A	18
Electrical	14 Gage	2	NA	1,000 V	10 A	12
Electrical	10 Gage	1	NA	3,000 V	30 A	6
Electrical	14 Gage	1	NA	10 KVDC	6 A	6
Optical	2.5 mm PC	2	12 Fiber	NA	NA	12
Optical	1.25 mm PC	8	48 Fiber	NA	NA	48
Optical	MT	12	72 Fiber	NA	NA	72

by potential users. New technologies can take decades to be developed and accepted. As underwater systems grow with new technologies, interconnecting systems will need to be higher in reliability and suitable for more rugged use in harsh environments.

Existing wet-mate connector manufacturers that have been bought by large corporations typically don't have the staff or funding to do R&D as they struggle to fulfill orders. They rely on the same designs developed in the 1990s, specifically for offshore oil and gas (O&G) undersea control module applications. These products perform reliably for most O&G applications, which typically involve: low connector interchange; low handling; highly controlled integration and test scenarios; highly controlled installation practices; and an ROV and ship on site for repair or replacement.

Defense systems, in contrast, are characterized by: high connector interchange and mixture of connector halves; high handling; multiple integration areas and test scenarios; less controlled installation practices; and no ROV and ship on site for maintenance.

Therefore, when a wet-mate connector built for O&G applications is used in defense systems, it can lead to costly and dangerous failures, such as: electrical connection failure due to low or contaminated oil volumes; optical connection failures due to low or contaminated fluid volumes; optical failure due to contamination resulting from no isolation barriers between electrical and optical contact environments; contamination

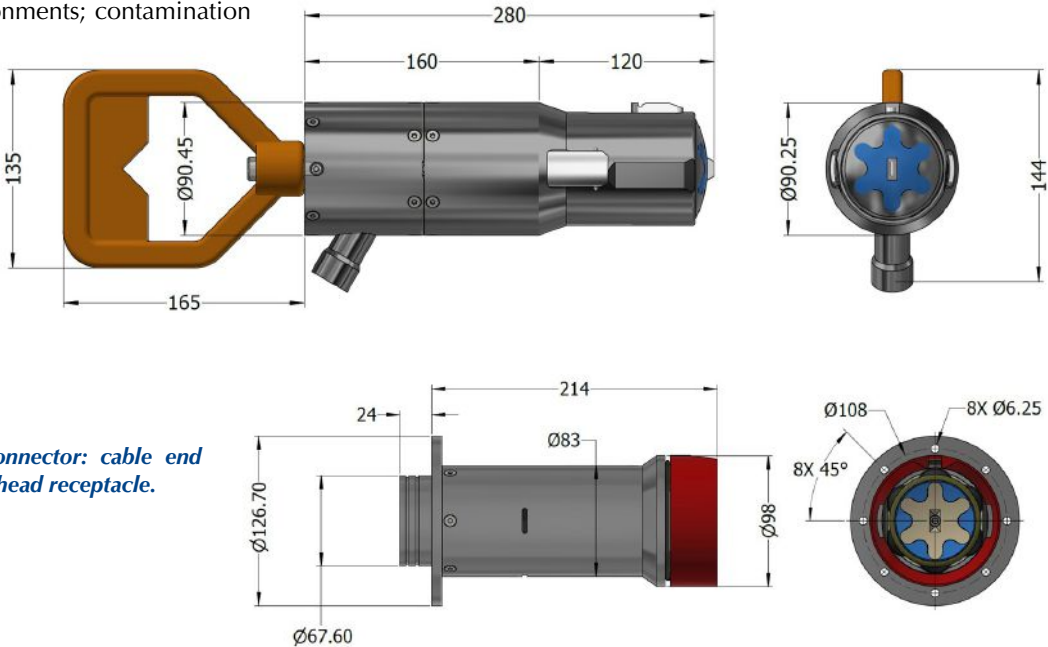
of new connectors from engagements with older contaminated connectors; oil depletion in a new connector by interchanging with a connector of depleted fluid volume; and inadequate sealing during engagement and disengagement, leading to water or debris-related contamination.

DL Series

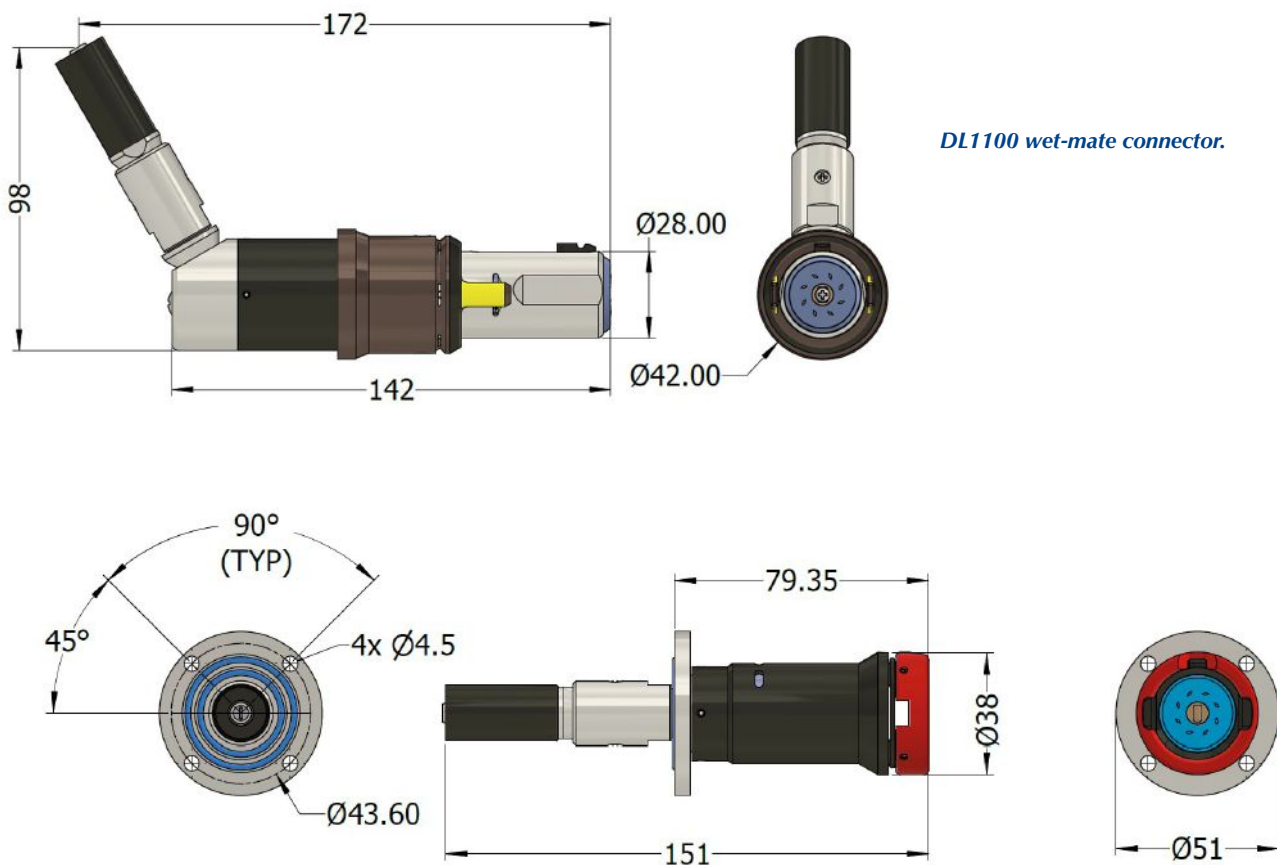
To combat these failures, Deeplinc has developed wet-mate connectors specifically for defense systems. Deeplinc's DL5500 wet-mate connector is the first major design disruption to the market in over 25 years. It meets the increased demand for higher reliability and eliminates current connector shortcomings for defense applications.

Deeplinc wet-mate connectors use proven commercial terrestrial telecommunication components in an undersea solution. The connectors' electrical and optical contacts are isolated at all times from integration with the surrounding environmental conditions—before, during, and after contact engagement and throughout the product life cycle. They enhance seafloor communication and power grid architectures by providing true plug-and-play systems. They offer reliable and repeatable mate and de-mate multichannels of optical or electrical contacts subsea. By using cable over a pressure-balanced,

DL3300 wet-mate connector: cable end (flying) plug and bulkhead receptacle.



DL3300 Optical Circuit Configurations				
Insert Type	Contact Type	Contacts Per Insert	Optical Capacity	Contact Availability w/max 6-Inserts per Connector
Optical	2.5 mm UPC	2	12 Fiber	12
Optical	2.5 mm UPC	3	24 Fiber	24
Optical	1.25 mm UPC	8	48 Fiber	48
Optical	MT	12	72 Fiber	72



oil-filled (PBOF) hose, they are built for long-term use. Additionally, all critical components are manufactured for vertical integration, allowing for high-volume production. This approach results in shorter lead times and flexibility in design.

The baseline DL5500 wet-mate connector is designed to overcome the conventional product shortcomings experienced in the market for more than a decade. The isolation technology is packaged to enhance system reliability and eliminate typical weak-link failure modes. It also provides: higher voltage and fiber counts; hybrid capability (fiber and electrical in the same connection); flexible configurations—the electrical and optical inserts are fully interchangeable; center line actuator to eliminate binding during mating operations; and completely isolated circuits.

The larger DL5500 connector includes a dual chamber to eliminate debris that enters the connector during multiple mates and in burial operations on the seafloor. Using a dual chamber extends operating life and increases the life of the connector from dozens to hundreds of engagement cycles—representing exceptional savings in any undersea applications.

The slightly smaller Deeplinc DL3300 wet-mate connector allows for up to 72 optical circuits. It is a direct bolt-on replacement for existing market wet-mate connectors with eight contacts for fiber or electricity. The DL3300 further enhances system reliability and eliminates typical connector weak-link failure modes in both defense communications and offshore O&G applications.

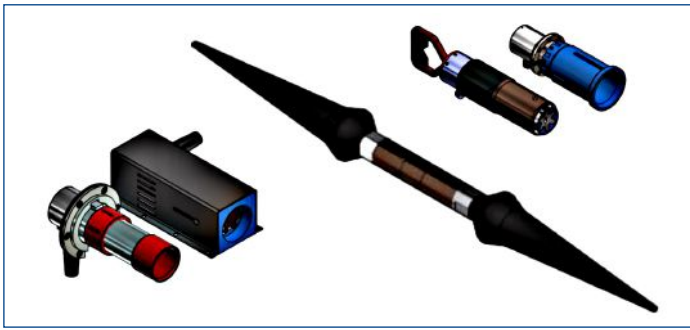
The compact Deeplinc DL1100 wet-mate connector is an eight-contact connector with fiber or electricity for harsh environments. The company believes it is the smallest wet-mate connector on the market today, and it plays a critical role in meeting connection needs in confined spaces. The connector can be used with tactical cable or a PBOF hose.

Deeplinc has developed three external package configurations. The Bulkhead/Flying-Lead package is typically used in non-burial subsea applications. The Full Cable Tension Over-Sheave package is used in operations with ship-laid systems. The Panel-Mount Stab is an economic solution for use with banked connectors on subsea racks.

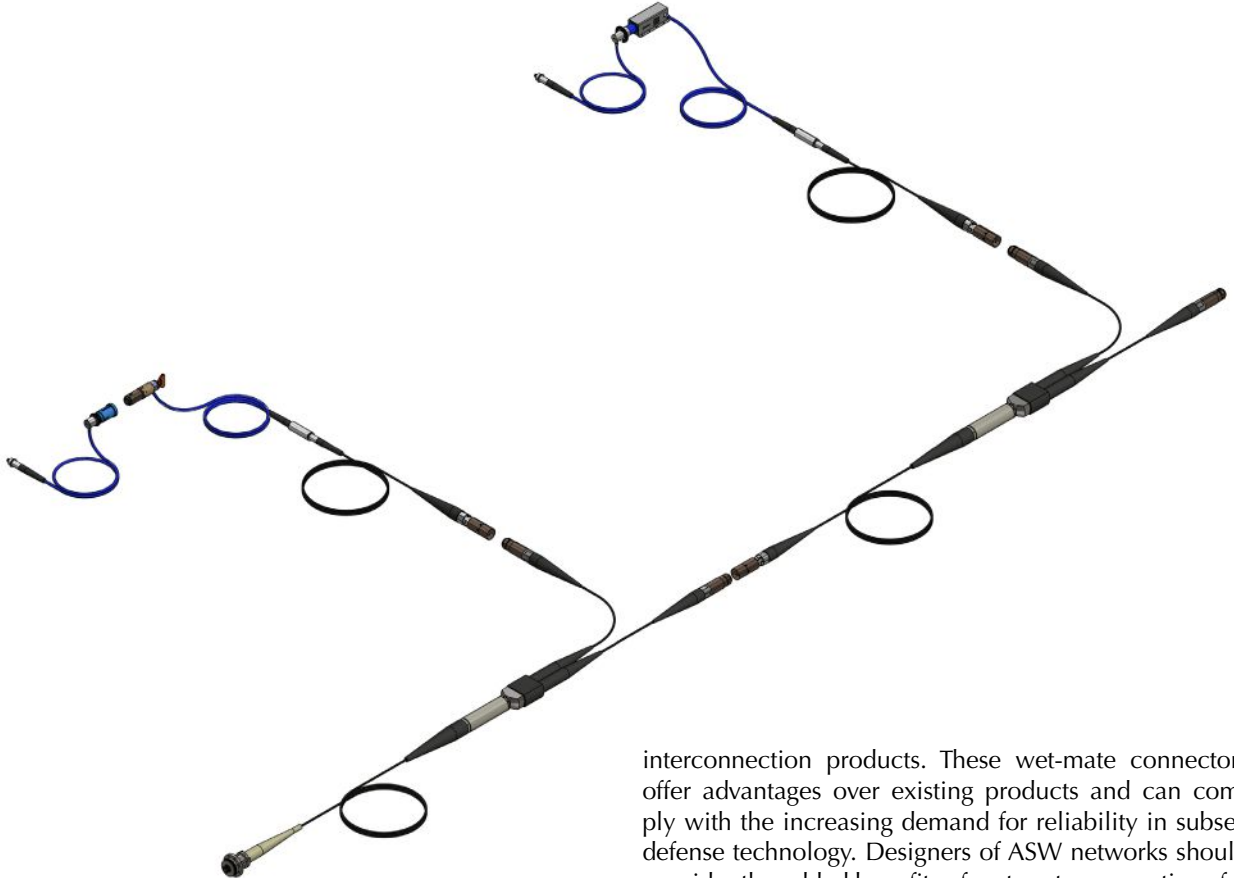
Potential Undersea Network Applications

Deeplinc's connectors can provide integral components for subsea calibration and naval training range networks, with range sizes that can encompass thousands of nautical square miles of ocean and airspace and provide critical infrastructure for submarines and ROVs. These training ranges operate via integrated networks that contain sensors, electronic, and optical equipment that communicates back to shore and topside platforms. With physical cable connections linking the network systems, the Deeplinc product suite can provide flexibility in range design and maintenance through wet-mateable submarine cable joints and connectors.

Deeplinc WMCs and ancillary equipment can create a cable system for subsea data acquisition networks, for example. A Deeplinc branching unit provides long-distance scalability of a network along the trunk cable. The



(Left) Package configurations. (Below) Deeplinc's wet-mateable submarine cable joints and WMCs can provide flexibility in undersea networks for naval training ranges.



DL5500 wet-joint, full cable strength WMC is used to attach sensors and equipment that branch off the main trunk cable. The DL3300 cable end flying lead and bulk-head receptacle integrate the sensors and equipment on the branch, and the miniaturized DL1100 WMC is used to enable ROVs to dock and transmit data on the network.

Configuring a subsea network this way provides flexibility in sensor array connections and expansion. The network can be maintained in sections for more efficient and reliable operation. Cabling systems configured in such a manner can support applications in both defense and emerging commercial systems. They are appropriate for networks where real-time subsea data acquisition increases exponentially through increased fiber and electrical capacity.

Conclusion

Deeplinc wet-mate connector technology is positioned to become the new standard for highly reliable

interconnection products. These wet-mate connectors offer advantages over existing products and can comply with the increasing demand for reliability in subsea defense technology. Designers of ASW networks should consider the added benefits of wet-mate connections for long-duration use when developing emerging systems. The choice in wet-mate connectors could be the difference between system success and failure. **ST**

John Toth is the founder and chief design engineer for Deeplinc. He holds 11 U.S. patents for harsh environment connections. He was previously division president and vice president of engineering for Ocean Design. He has also worked in submarine towed sonar array R&D. Toth holds a master's in mechanical engineering from the University of Rhode Island.

Greg Scull is the president of Deeplinc, responsible for operations. He has held management positions with Ocean Design, Teledyne Oil & Gas, Lockheed Martin Aero and Naval Systems, Litton Poly-Scientific (Now Moog), and Gould's Advanced Systems Development Division. Scull holds a bachelor's degree in industrial engineering from the University of Maryland.

Don Heinz is a product engineer for Deeplinc, responsible for development and testing of wet-mate connectors. He was a senior product engineer for Teledyne Oil & Gas and an engineer for American Can. Heinz has more than 25 years of experience with development and testing of wet-mate connectors and ancillary equipment.

ROVs for Safety, Security

ROVs with Novel Positioning Tech Enhance Naval Operations

By Cody Warner

In modern naval operations, ensuring the safety, security, and functionality of both vessels and critical infrastructure is crucial. The increasing use of unmanned technology, particularly ROVs, is reshaping how these tasks are managed. ROVs have proven to be essential tools in various naval applications, from infrastructure monitoring and vessel inspections to naval damage control and explosive ordnance disposal (EOD). This article explores how ROVs are enhancing naval operations and highlights recent technological developments that are pushing the capabilities of these systems even further.

Facility and Vessel Maintenance

Navies around the world rely on robust infrastructure, including shipyards, piers and docks, to maintain their fleets. Ensuring these facilities are free of threats and in working order is essential. Underwater inspections, however, present significant challenges due to the difficult conditions in which divers often operate. ROVs provide a solution by offering the ability to conduct real-time inspections without the need to place humans at risk.

For instance, naval shipyards, such as the U.S. Navy's Southwest Regional Maintenance Center (SWRMC), uses

Navies around the world use ROVs to ensure shipyards, piers, and docks are free of threats and in working order.



(Top) ROVs enable rapid and precise damage control assessment for naval assets. (Bottom) Deep Trekker's ROVs offer dead reckoning and a GPS system to recalibrate an ROV's position within seconds when surfacing.



Deep Trekker ROVs to inspect submerged portions of piers, detect cracks or corrosion on structures, and identify potential security threats, such as unauthorized objects placed underwater. By using sonar-equipped ROVs, SWRMC can maintain constant vigilance over their facilities, identifying and addressing potential hazards quickly and efficiently.

ROVs are equally useful for vessel inspections. Whether for routine maintenance or post-incident damage control, ROVs can be deployed to survey the hulls of ships, assess the condition of propellers, and identify any foreign objects or potential weaknesses that could jeopardize naval assets. Their ability to perform these tasks in confined, hard-to-reach spaces makes them indispensable in modern naval operations. For example, an ROV could inspect a ship's hull after a collision or grounding

to identify structural damage before a repair plan is enacted.

Rapid Response Damage Control

Naval operations often occur in challenging environments, where damage to a ship's underwater sections can be difficult to assess and repair. When damage occurs, rapid and precise assessments are critical for effective damage control. Traditionally, divers would need to risk their lives in often hazardous conditions, but with the advent of ROVs, these risks are significantly reduced.

ROVs allow for quick underwater surveys following incidents such as collisions, grounding or enemy attacks. The use of ultrahigh-definition 4K video cameras and sonar systems on

ROVs enables naval teams to gain a comprehensive understanding of the damage in real time. With this information, decision makers can determine the appropriate course of action, whether it involves immediate repairs or further assessment. ROVs are now integral tools for naval damage control teams, providing a safer and faster means of evaluating critical damage to vessels.

Explosive Ordnance Disposal

One of the most dangerous naval operations is the detection and disposal of underwater explosives. Mines, unexploded ordnance, and other explosive devices pose severe threats to vessels, naval infrastructure, and personnel. Traditionally, EOD teams had to approach these dangerous devices manually, putting themselves at great risk. Today, ROVs have become vital in EOD operations,



allowing teams to safely neutralize threats from a distance.

Equipped with specialized tools and manipulators, ROVs can locate, identify, and disarm underwater mines or explosives. Their precision and remote operation capabilities enable them to perform these tasks without endangering human lives. For example, a naval fleet approaching a port may deploy ROVs to survey the area for mines, ensuring safe passage for the ships. The ability to operate in both shallow and deep waters makes ROVs versatile tools in EOD missions.

Navigation Advancements

As naval operations evolve, so too do the capabilities of ROVs. Deep Trekker, a leading manufacturer of ROVs, is at the forefront of these advancements. With thousands of ROVs deployed by the navies of more than 100 countries, including the U.S. Navy and the navies of Korea, Brunei, and Germany, Deep Trekker's ROVs are well-established as indispensable tools in defense operations.

One of the most significant developments in recent years is the introduction of dead reckoning technology. Deep Trekker's ROVs are the only vehicles in their size class equipped with this capability.

Dead reckoning enables precise underwater navigation by calculating the ROV's position based on its previous location, speed and direction. This eliminates the need for bulky underwater positioning systems such as USBL, which can be unreliable. With dead reckoning, naval teams can easily track where an ROV has been, ensuring thorough inspections and making the entire process more efficient.

In addition to dead reckoning, Deep Trekker's ROV GPS system is another game-changing innovation. This periscope-style attachment enables operators to recal-

ibrate an ROV's position within seconds when surfacing, ensuring precise navigation even in complex environments. This capability is especially valuable during prolonged operations or in areas where GPS signals may be lost due to obstructions.

Canada's Ocean Supercluster Projects

Exciting developments are on the horizon that will further enhance naval operations through the use of unmanned technology. Three such projects are AROWIND, SENTRY and the AI ROV Ship Modeling and Detection Project, which are part of Canada's Ocean Supercluster initiative.

The AROWIND project involves the creation of a USV that can deploy an ROV for remote operations. This is highly beneficial in scenarios where human presence poses a significant risk, such as in hostile environments or during long-range surveillance missions. One of the challenges of ROVs is their limited operational range due to the need for tethered connections to human operators. AROWIND addresses this by extending the range of ROVs, enabling their deployment over long distances while keeping personnel out of harm's way. This technology will undoubtedly play a critical role in future naval missions that require remote operations in challenging environments.

The SENTRY project aims to revolutionize how ROVs are deployed and maintained. SENTRY enables the permanent installation of ROVs in strategically important locations, housed in underwater garages. Operators can "log in" remotely to an ROV stationed in these garages, allowing for immediate deployment whenever needed. This capability is important for monitoring high-priority naval areas, such as ports or offshore installations. With SENTRY, the ROVs are always on standby, ready to conduct inspections or threat assessments without the need for lengthy preparation times.



One of the challenges of ROVs is their limited operational range due to the need for tethered connections to human operators. The AROWIND project will use USVs as a platform to extend the range of ROVs.

“ROVs have proven to be essential tools in various naval applications, from infrastructure monitoring and vessel inspections to naval damage control and explosive ordnance disposal (EOD).”

The AI ROV Ship Modeling and Detection Project aims to transform ship hull inspections by using advanced ROVs equipped with multiple cameras and sonar systems to collect real-time underwater data, which are analyzed by Qii.AI software to detect defects. Integrated positioning sensors ensure consistent accuracy, even in challenging conditions. In partnership with Qii.AI, Canada's Department of National Defence, Kongsberg Discovery Canada Ltd. and ABS Canada, the project will improve maritime safety, environmental protection and operational efficiency.

Conclusion

ROVs are transforming naval operations, providing faster, safer, and more efficient solutions for infrastructure monitoring, vessel inspections, naval damage control, and EOD missions. As technology continues to evolve, advancements such as dead reckoning, ROV GPS, and projects such as AROWIND and SENTRY will further en-

hance the capabilities of ROVs, improving the effectiveness of naval operations and reducing risks to personnel.

The role of companies such as Deep Trekker in developing these technologies is pivotal. By continuing to innovate and push the boundaries of what is possible with unmanned systems, the future of naval operations will be safer, more precise, and more capable. As the global defense landscape evolves, ROVs will remain at the heart of naval innovation, enabling mission success and ensuring maritime security for years to come. **ST**

As Deep Trekker's director of sales and marketing, Cody Warner has spent 10 years pioneering ROV usage across many industries. His hands-on approach to research and field inspections has driven product innovation, custom add-ons, and software upgrades, and he continuously explores new technologies to serve the needs of critical industries.

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Edge Processing for ROVs

Intelligent INS Systems Enable Vehicle Autonomy

By David Pearson

In the ever-evolving field of subsea robotics, Greensea IQ has again pushed the boundaries with the introduction of its innovative IQNS and IQNS Mini systems. These cutting-edge products represent Greensea IQ's next generation of intelligent inertial navigation systems, combining advanced edge processing with superior navigation accuracy, autonomy and safety.

With their powerful edge processing capabilities, modular and scalable design, and enhanced navigation accuracy, the IQNS and IQNS Mini are poised to transform the way underwater operations are conducted. Whether in defense, commercial or scientific applications, the IQNS systems offer a versatile and reliable solution that enhances mission success while reducing the workload and risk for operators.

The Power of Edge Processing

At the heart of both the IQNS and IQNS Mini is an NVIDIA processor, a powerful edge processing platform that enables real-time data processing directly on the vehicle. This is a game-changer for underwater robotics, as it significantly reduces the reliance on high-bandwidth communications with surface operators. In traditional systems, data must be transmitted to the surface for processing, but by shifting the processing capabilities to the vehicle itself, the IQNS systems allow for faster decision making and more responsive operations, making tetherless operation a possibility.

IQNS and IQNS Mini deploy the EOD (explosive ordnance disposal) Edge software stack, representing the next step toward greater efficiency and

increased operational standoff in EOD operations. EOD Edge is a guidance, navigation, command and control software solution designed to be deployed on subsea robots, enabling the use of lower-bandwidth communications, autonomous behaviors and onboard sensor processing, such as object classification and engagement and shift central processing from the operator's computer to the vehicle. This enhancement provides an improved user experience with additional modes of autonomy and advanced sensor processing capabilities.

The IQNS and IQNS Mini can perform tasks such as automatic target recognition (ATR), obstacle avoidance, and target tracking in real time, without the need for constant communication with a surface operator. This not only improves the efficiency and effectiveness of the mission but also enhances the safety of the operators by allowing the vehicle to operate autonomously in dangerous environments.

Modular and Scalable Design

Understanding that space on ROVs is limited, Greensea IQ designed the IQNS and IQNS Mini to be both modular and scalable so that, as processing power demands increase or as new processing technologies emerge, the IQNS systems can be easily upgraded or replaced, ensuring that they remain at the cutting edge of

The IQNS is an intelligent inertial navigation system that combines advanced edge processing with superior navigation accuracy, autonomy and safety. It measures approximately 4.5 in. per dimension.





the industry while having the ability to be daisy-chained, increasing processing power as needed.

Greensea IQ also recognized that in the rapidly advancing field of subsea robotics, flexibility and adaptability are key for integrating additional sensors or payloads, which can expand the capabilities of the vehicle. Whether it's adding new sensors for more accurate data collection or increasing processing power for more complex missions, the IQNS systems are designed to grow with the needs of the user. This flexibility makes them ideal for a wide range of applications, from military operations to scientific research and commercial use.

Compatibility with EOD Workspace and OPENSEA

The IQNS and IQNS Mini are fully compatible with Greensea IQ's field-proven EOD Workspace and OPENSEA platforms. This compatibility ensures that the systems can be seamlessly integrated into existing subsea robots, facilitating the implementation of advanced features, such as autonomous navigation, obstacle avoidance and target tracking.

EOD Workspace is a software suite designed to support EOD operations in maritime environments. It provides a comprehensive solution for automating the detection and neutralization of subsea threats, and with the addition of IQNS's edge processing capabilities, these tasks can be carried out with greater speed and precision.

OPENSEA is Greensea's open-architecture software platform that enables the integration of third-party hard-

ware and software components. The compatibility of IQNS with OPENSEA allows users to customize their systems according to their specific needs by tapping into the wide range of sensors already integrated with OPENSEA.

Enhanced Navigation Accuracy

Accurate navigation is critical in subsea operations, where GPS signals are often unavailable, and the environment can be unpredictable. The IQNS system addresses this challenge by integrating multiple aiding sensors, including DVL, GPS and USBL positioning systems. This sensor fusion approach allows the IQNS to maintain precise dead-reckoning navigation even in GPS-denied environments, a feature that is particularly valuable for long-duration missions in deepwater or complex terrains.

One of the standout components of the IQNS is the single-axis fiber-optic gyro (FOG), which provides exceptional heading stability. This technology ensures the vehicle maintains a steady course, even in challenging conditions where other systems might struggle. For operations such as pipeline inspection, underwater construction or mine countermeasures, where precise navigation is critical, the IQNS offers a robust solution that enhances mission success.

Autonomy and Safety

The IQNS and IQNS Mini systems' key focus is autonomy, and central to this is their edge processing capabilities. By processing data directly on the vehicle, the IQNS systems can execute complex tasks autonomously,

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The IQNS Mini, like the IQNS, is modular and scalable to accommodate increasing processing power demands or new processing technologies.

reducing the need for constant human intervention. This is particularly important in hazardous environments, where minimizing the exposure of human operators to danger is a priority.

The IQNS systems are designed to implement contingency behaviors, such as returning to a safe location if communication with the surface is lost. This feature enhances the system's safety and reliability, ensuring that the vehicle can continue to operate effectively even in the event of unforeseen issues.

In addition to enhancing safety, the IQNS systems' autonomy also reduces the operators' workload. With the vehicle able to make decisions and execute tasks independently, operators can focus on higher-level mission planning and oversight, improving overall efficiency.

Sonar Feature Detection and Obstacle Avoidance

The IQNS system utilizes its advanced edge processing capabilities to significantly enhance the performance of forward-looking sonar (FLS), a critical tool operators prefer for situational awareness, which can now be used for enhancing subsea navigation and obstacle detection and avoidance. In underwater environments, where visibility is often poor, sonar becomes indispensable for detecting features and identifying potential obstacles. With the IQNS, the operators can rely on the system to detect and track sonar features, so they can focus on the mission.

The IQNS system employs sophisticated algorithms to process sonar data in real time, allowing it to detect obstacles and dynamically adjust the vehicle's path to avoid

them. This real-time obstacle detection and avoidance are vital for navigating complex underwater terrains, where the presence of rocks, shipwrecks or other impassable areas can pose significant risks.

By enabling autonomous obstacle detection and avoidance, the IQNS system eliminates the need for human intervention, enhancing both the safety and operational efficiency of the vehicle. Whether navigating through cluttered environments or steering clear of potential threats, the IQNS system provides a robust and reliable solution for ensuring mission success and vehicle integrity in challenging underwater conditions.

Applications and Prospects

The capabilities of the IQNS and IQNS Mini have been proven through rigorous testing and deployment in real-world scenarios. For example, the systems have been integrated into Greensea IQ's Bayonet Autonomous Underwater Ground Vehicle (AUGV) product line (Sea Technology, November 2022), where they have demonstrated their ability to enhance navigation, autonomy and safety.

In summer 2024, Greensea IQ successfully conducted a field test of the IQNS system using a Bayonet 250 at the waterfront of its office space. The goal was to demonstrate IQNS's advanced capabilities in recognizing and avoiding underwater hazards in real time. The system performed flawlessly, detecting obstacles and autonomously adjusting its course to avoid them, showcasing its robust navigation and perception features. The test was later repeated for potential customers at their own facilities, where the system again demonstrated its reliability and potential for undersea defense applications.

Looking ahead, the potential applications for the IQNS and IQNS Mini are vast. In the defense sector, these systems can play a crucial role in missions such as mine countermeasures, surveillance and reconnaissance. In the commercial sector, they offer valuable tools for underwater construction, inspection and maintenance, particularly in the growing field of offshore wind energy.

As the demand for autonomous subsea systems continues to grow, the modularity and scalability of the IQNS systems will ensure that they remain at the forefront of the industry. By combining advanced edge processing with superior navigation accuracy and autonomy, Greensea IQ is setting new standards in underwater robotics. **ST**

David Pearson, CMarTech, is a chartered marine technologist with MTS and a technical solutions architect at Greensea IQ. With over a decade of experience in marine technology, he has worked across USVs, UUVs, ROVs and, now, Bayonet AUGVs, leading teams to develop cutting-edge solutions for various marine applications.

Prediction of Waves and Vessel Motion

Applying Radars and AI to Deterministic Prediction

By Dr. Rune Gangeskar

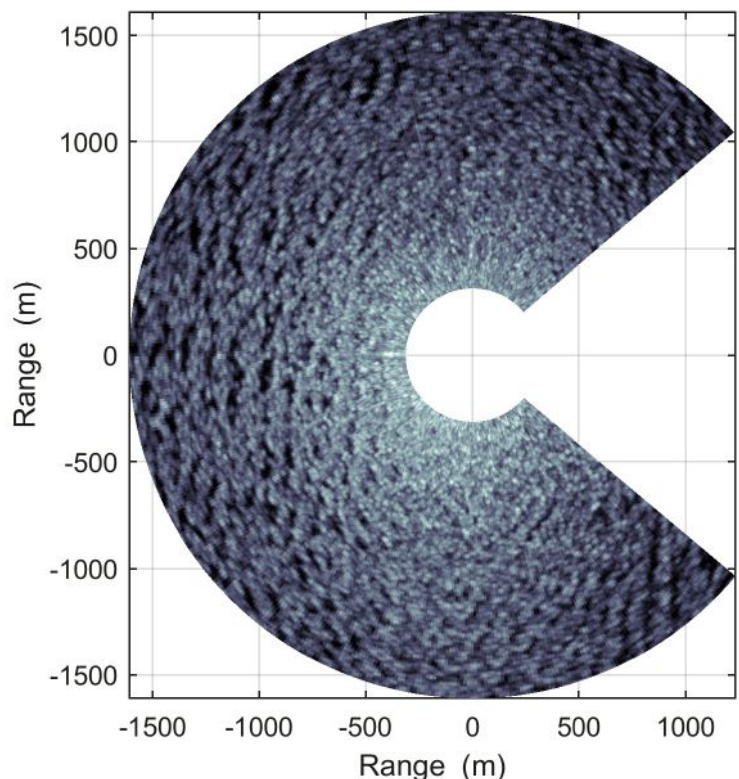
Sea states and ocean currents can be reliably measured by radars. Traditional and mature radar-based technology typically provides ocean wave spectra along with statistical wave parameters, such as significant wave height and wave periods, as well as near-surface current vectors. Wavex, the Wave & Current Radar and the RangeFinder, all designed and developed by Miros (Asker, Norway) are examples of such systems. They are based on imaging radar, Doppler radar and frequency modulated continuous wave (FMCW) technology, respectively.

More recently, resources have been put into developing radar-based systems that can provide deterministic prediction of ocean waves and vessel motion. Deterministic prediction can be used to monitor and track specific waves and predict their impact in the range of seconds to minutes, giving offshore personnel advanced warning that waves and motion with certain characteristics are approaching. Statistical prediction, on the other hand, can provide information about how the sea state and statistical parameters will develop in the range of minutes to hours or days, but without addressing individual waves.

For deterministic prediction, imaging radars and systems like Wavex have often made a beneficial starting point for further development, as wave patterns on the sea surface, in a reasonable area around the radar antenna, are visible to the radar. This is due to electro-

magnetic backscatter from short wind-generated waves, along with several modulation mechanisms, typically divided into tilt modulation, hydrodynamic modulation and shadowing. Radar images can be digitized by hardware specially developed for the application of interest, or they can be acquired directly from radars with digital data feed, commonly known as internet protocol (IP) radars, eliminating the need for additional digitalization hardware.

Despite significant progress within deterministic prediction in recent years, the technology has been consid-



Example of digitized image from conventional marine X-band navigation radar operating in short pulse mode, with clearly visible wave patterns. Time series of such images are fundamental inputs to the wave and motion prediction system.

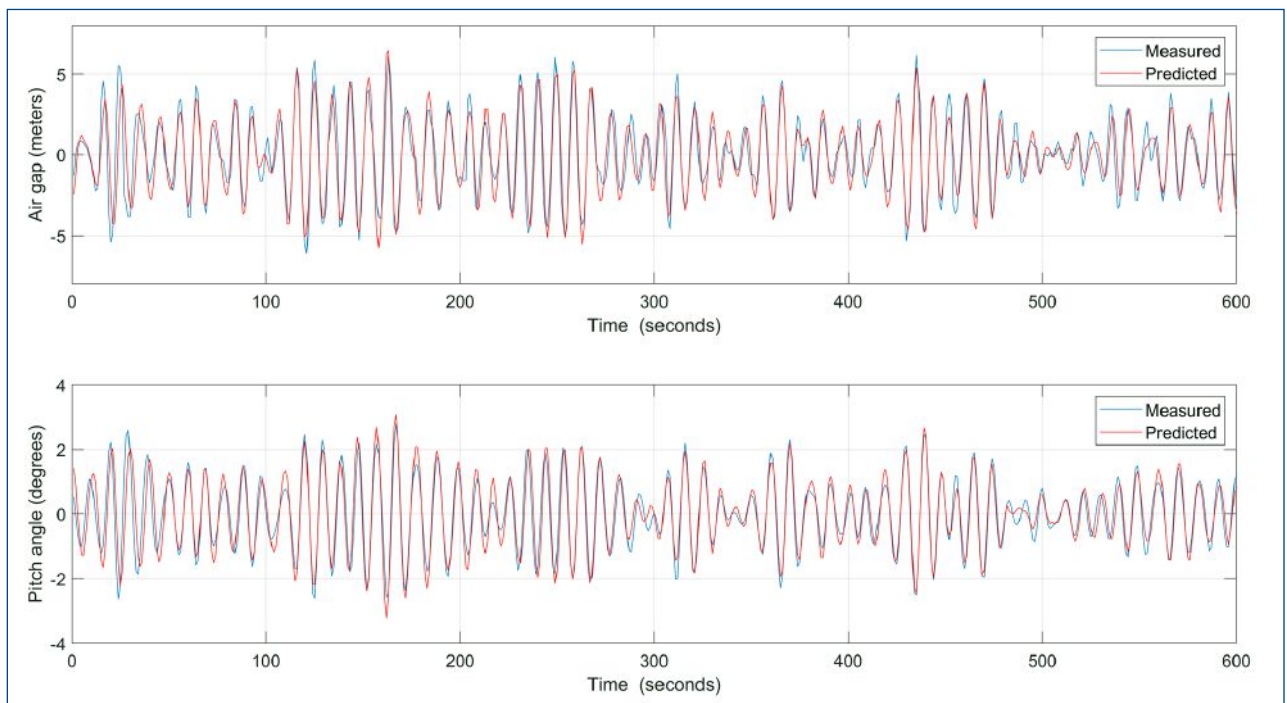


(Top) Real-time screenshot of heave and pitch from Edda Freya in the field. The vessel heading is pointed toward incoming waves, and the significant wave height is 3.1 m. (Bottom) Real-time screenshot of roll from Edda Freya in the field. The significant wave height is 3.6 m.

ered immature and not able to provide reliable data under a wide range of non-ideal measurement conditions. The traditional methods have often been associated with limitations, for instance, when it comes to multimodal sea states; non-linear ocean wave effects; requirements to the radar installation geometry, which are difficult to

fulfill; and insufficient knowledge about the link between a specific sea surface time series and the corresponding vessel motion. By combining several different radar sources and traditional methods with novel algorithms and artificial intelligence (AI), however, Miros has developed a new-generation system bypassing many of these challenges. The algorithms automatically adapt to varying sea and weather conditions. New models are reliably handling multimodal sea states and non-linear effects.

A huge amount of data has been collected, covering a wide range of measurement conditions. Algorithms and software have been integrated into a complete pilot system and installed on a vessel, providing prediction of surface height and vessel motion in the range of 10 sec. to 2 min. Outputs of the system are: surface height, air gap between the sea surface and specific points on the



Long-term historical time series of air gap (from downward-looking radar to sea surface) and pitch angle from Edda Freya, covering 10 min. with several wave trains, comparing 30-sec. predictions (red) and measurements (blue).

moving vessel, and up to six motion parameters (heave, surge, sway, yaw, roll and pitch), depending on which parameters are physically related to incoming waves on the installation of interest. A graphical user interface (GUI) displays the data of interest and can be configured with operation limits for the various parameters to make critical information easily available to the user during offshore operations. So far, the system has delivered promising results with reasonable accuracies under a wide range of conditions.

Data Acquisition and Pilot

A large number of data has been acquired from various radar systems and sensors on the construction vessel *Edda Freya* of DeepOcean (Oslo, Norway) during the last few years. Recently, a prediction pilot system with fully operational real-time software and GUI was also installed on board. In addition, data have been acquired from other installations in other areas, with various installation geometries, other typical measurement conditions and different radar models.

The Prediction System

The system typically comprises at least one conventional marine X-band navigation radar and at least one downward-looking radar, such as the Miro RangeFinder. Furthermore, the system contains various sensors providing information about vessel motion. Data from radars

and sensors are collected and processed on a dedicated PC, and the results are displayed in a configurable GUI. The system algorithms are based on both classical theory and novel AI-based methods. They automatically change their properties based on the available inputs to adapt to various sea states and measurement conditions. In addition, access to various inputs makes it possible to compare predicted parameters with true measurements and continuously evaluate and display the system performance in real time.

For parameters being physically related to incoming waves visible by the radar, a decent correlation in the range of typically 0.85 to 0.95 is obtained between predicted values and measured values, along with a relatively low root-mean-square (RMS) deviation. “Being physically related to incoming waves” refers to situations in which incoming waves explain a major part of the vessel motion parameter of interest, and not, for instance, crane operations or dynamic positioning (DP), which cannot be predicted without further input to the system.

For some applications, correlation is the most interesting parameter, providing a measure of covariance between predicted and measured values, when the shape of the time series or the precise timing of a particular event is important. For other applications, however, RMS deviation may be equally or more important, for instance when the maximum wave or motion amplitude is of interest. Typically, the measurement accuracy is relatively stable or slightly decreasing with increasing prediction times in the range of 20 to 60 sec., and then decreasing more rapidly up to 2 min.

The system can be configured to fit the application of interest, for instance, with various radar models and sensors, customized requirements for data inputs, various prediction times, and various operation limits. Operation limits can be shown along with uncertainty zones in the GUI, indicating the current accuracy level in the predic-

“Deterministic prediction can be used to monitor and track specific waves and predict their impact in the range of seconds to minutes, giving offshore personnel advanced warning that waves and motion with certain characteristics are approaching.”

tion of interest. The system may also be used on a fixed site, without motion prediction, to predict ocean surface height or, alternatively, air gap.

Results from Pilot

The new prediction technology has been thoroughly tested during the research and development phase by means of data acquired from the various installations. The recently installed operational pilot system at *Edda Freya* is now being used to verify that the technology works under real-world conditions. This also brings the system development process into a new stage, in which feedback and user experiences from actual operations can be utilized to further develop the product for specific applications and to present measurements and critical information in the most suitable way to the user. The system at *Edda Freya* is monitored closely to observe how it works under various conditions. Output data are transferred and stored to Miros Cloud, and screenshots of the GUI are stored for input to upcoming adjustments.

Conclusion

Sea states and ocean currents can be reliably measured by radars. Deterministic wave and motion prediction can be used to monitor and track specific waves and predict their impact in the range of seconds to minutes, giving offshore personnel advanced warning that waves and motion with certain characteristics are approaching, whereas statistical prediction can provide information about how the sea state and statistical parameters will develop in the range of minutes to hours or days, without addressing individual waves.

A new-generation system for deterministic prediction has been developed, based on combining several different radar sources and traditional methods with novel algorithms and AI. The new system automatically adapts to varying sea and weather conditions, and it reliably handles multimodal sea states and non-linear effects. A fully operational real-time software and GUI is currently installed on DeepOcean's construction vessel *Edda Freya*, facilitating system verification and giving input for further development toward a finished product that will provide critical information and increased value to the customer.

Acknowledgments

The author would like to thank DeepOcean for making available and approving data, information and results to be used for this work. The author would also like to thank other external partners, as well as V.S. Bertelsen and G. Prytz from Miros, for their support in acquiring data and providing valuable information and input during the project. **ST**

Dr. Rune Gangeskar holds a Ph.D. in physics and instrumentation from the University of Oslo. He is a senior principal engineer with Miros AS in Asker, Norway, where he is involved in developing measurement principles, algorithms, mathematical models and software for various radar-based systems measuring environmental data at sea.

An advertisement for the Saab eM1-7 Electric Manipulator. The background is a dark blue gradient with bright blue light streaks at the bottom. On the left, the word "EMPOWERING" is written in large, white, sans-serif capital letters. Below it, in smaller white text, is "World leading electric underwater robotics". Further down is "Seaeeye eM1-7 Electric Manipulator". At the bottom left is the Saab Technology logo, which consists of a circular emblem with a griffin and the word "SAAB" above it, followed by the word "TECHNOLOGY" in a smaller font. To the right of the text is a detailed image of the electric manipulator, showing its gripper and various mechanical components. The manipulator is dark blue and black with some metallic parts.

international

Interocean Expands in Norway

Interocean Marine Services has added offices in Stavanger, Oslo and Kristiansand, Norway. Earlier this year, the company, headquartered in the U.K., opened new premises in Glasgow and Aberdeen.

The new Norwegian offices will increase Interocean's headcount by 10 percent over the next two years, bringing the total company headcount to 60.

Formed in partnership with Southern Marine, a Seafront Group company, Interocean's new Norwegian locations will be led by Seafront Group AS Board Member Thomas Granfeldt, Jr., alongside Intermediate General Manager Kjetil Hansen.

AEGIR-Marine Seeks Sustainability Certification

AEGIR-Marine, the Netherlands-based stern tube seal and propulsion system service provider, has applied for B Corp certification. The move represents the company's next step in its drive to raise the level of sustainability throughout its operations. B Corp certification is an assessment of a company's social sustainability and environmental performance standards with full accountability and transparency.

DNV Report Calls for Vessel Energy Efficiency

Reaching shipping's 2030 decarbonization goal of 20 percent emission reductions set by the International Maritime Organization (IMO) will not happen without significant energy savings, according to DNV's latest Maritime Forecast to 2050. The report stresses that, until carbon-neutral fuels become viable, prioritizing the development and use of technologies that reduce energy consumption is crucial for lowering shipping's emissions. Operational and technical energy efficiency measures can reduce fuel consumption by 4 to 16 percent by 2030, the report states.

Piping Supply Chain Agreement

W&O, a supplier of valves, actuation, piping systems and instrumentation to the global maritime industry, has been appointed a maritime partner by the manufacturer GF Piping Systems. W&O will stock the company's systems at supply hubs in Europe, the U.S. and Asia. The agreement will help customers streamline supply chain dynamics by significantly reducing lead times and associated costs for procurement, logistics, installation, repair, and maintenance.

Methanol Tugs for Canada

Sanmar Shipyards, Turkey's oldest tugboat company, has chosen Auramarine as its supplier for methanol supply systems on two large dual-fueled methanol tugs. The tugs are owned by KOTUG Canada and will enter service in mid-2025, making them the first of their kind.

The tugs are based on the RAsalvor 4400-DFM design by Robert Allan Ltd. (*Sea Technology*, June 2023), measuring 44 m in length, with the capability to operate

in harsh environments. They will serve Canada's Trans Mountain Expansion Project and will escort tankers from the harbor limits of Vancouver to the open Pacific Ocean through the commercial shipping lanes of the Salish Sea. The vessels will be the most powerful escort tugs in Canada, capable of achieving a massive 120 tonnes of bollard pull. They will also provide reduced greenhouse gas emissions and underwater radiated noise, which protects the Salish Sea's resident Killer Whales.

Emission-Free Pelican FCS

Corvus Energy's Corvus Pelican Fuel Cell System (FCS) has received type approval from DNV. The system, which was developed through the three-year-long H2NOR project, is the first FCS designed to be inherently gas safe.

The first Corvus Pelican FCS is ready to be installed on board MS *Skulebas*, a 35-m fishing and training vessel owned by Vestland County and operated by Måløy Upper Secondary School in Norway. The vessel already has a 1-MWh battery system on board. By adding the Corvus Pelican FCS and hydrogen storage, the vessel will be able to operate for four days with zero emissions.

Vessel Performance System for Turkish Ships

StormGeo and Danelec have successfully implemented an advanced vessel performance optimization system for 48 Turkish vessels owned by the shipping companies Arkas and Er Shipping. The solution integrates Danelec's onboard and cloud infrastructure with StormGeo's vessel performance solutions for managing the commercial, technical, and environmental performance of entire fleets.

The collaboration between Danelec and StormGeo began in 2023 to fulfill the needs of StormGeo's partnership with the Turkish Shipowners' Association. The project highlights the technology-agnostic nature of Danelec and the Danelec Collect onboard infrastructure while boosting the total number of Turkish ships using StormGeo's vessel performance solutions to 225.

PML Joins Seabed 2030

The Nippon Foundation-GEBCO Seabed 2030 Project has entered into a new partnership with Plymouth Marine Laboratory (PML), particularly in areas relating to climate change, biodiversity, cleaner seas and sustainable ocean management. The collaboration will see the two parties work together to advance understanding of the ocean and support efforts to achieve a fully mapped seafloor.

Port of Dover Pilot Vessel

The Port of Dover is proud to announce the arrival of its newest pilot vessel, DHB Diligent, developed in collaboration with Holyhead Marine. This investment underlines the port's ongoing commitment to enhance operational excellence, crew welfare, sustainability and safety within one of the U.K.'s busiest ports.

DHB Diligent is equipped with the BareFLEET advanced vessel performance monitoring system designed by AST Reygar, which was specified as a mandatory re-

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quirement in the tender process. The decision to include such a monitoring system reflects Dover Harbour's focus on leveraging technology to improve fuel efficiency, reduce carbon emissions, and ensure strict adherence to harbor regulations.

Ship-to-Ship Ammonia Transfer

The world's first ship-to-ship transfer of ammonia using vessels at anchorage in a working port environment has been completed. The transfer is a significant step toward realizing ammonia as a shipping fuel and to enable bunkering worldwide.

The operation is a result of the collaborative relationship between Yara Clean Ammonia, Pilbara Ports Authority and the Global Centre for Maritime Decarbonisation. It was conducted in Port Dampier, Australia, as part of the work to enhance the Pilbara region's potential as a bunkering hub to fuel ships with low-emission ammonia. Low-emission ammonia is produced with renewable energy and electrolysis of water or with carbon capture and storage. Ammonia does not emit CO₂ when burned.

Innovasea Aquaculture Tech in Iceland

Innovasea's (*Sea Technology*, May 2024) land-based aquaculture systems are now available in Iceland via Thor Salmon, who is installing Innovasea's Gas Management Towers (GMT) at its Icelandic smolt facility. The GMT leverages gravity, not pressure, to move water. This innovative solution to oxygenation can cut energy costs by up to 77 percent compared to a pressurized oxygen system.

Thor Salmon will use three GMTs, several dissolved oxygen sensors, and an automated control panel to more efficiently monitor and control changing oxygen levels remotely in its smolt facility currently being built in Thorlakhshofn, South Iceland.

Innovasea's Icelandic operations will be conducted out of its Norway office, and the company has partnered with the Iceland-based technology company KAPP to deliver its solutions to Iceland.

ASV for Canada Coast Guard

The Marine Environmental and Hazard Response unit of Haida Gwaii has acquired the first-ever ASV of the Canadian Coast Guard. This is the result of a collaboration between Shift Coastal Technologies, a specialist in marine autonomous systems, and the Canadian Coast Guard's Chief of Autonomous Systems Marty Rogers.

The OceanSled Ranger is a shallow water, multi-mission ASV. The Canadian Coast Guard intends to use the OceanSled for marine emergencies, including missing persons and coastal environmental protection.

VideoRay and SES Deepen Collaboration

VideoRay and Survey Equipment Services (SES) have expanded their dealer relationship. This enhanced partnership allows SES to sell VideoRay's Mission Specialist products across more of the U.S. SES is also on track to begin providing local customer service and support upon completion of training. **ST**

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First US Floating Offshore Wind Energy Research Lease

The U.S. Bureau of Ocean Energy Management (BOEM) has executed the nation's first floating offshore wind energy research lease. The lease area covers 9,700 acres located 28 nautical mi. offshore Maine on the U.S. Outer Continental Shelf and could allow for the deployment of up to 12 floating offshore wind turbines capable of generating up to 144 MW of renewable energy.

The research lease will allow the state, fishing community, wildlife experts, and others to conduct in-depth studies and thoroughly evaluate floating offshore wind as a renewable energy source in the region. Information gathered from the research lease will inform responsible commercial floating offshore wind development in the future and allow BOEM and Maine to capitalize on innovative technology, while protecting local and national interests and industries.

As a research lease, Maine or its designated operator will propose and conduct research regarding environmental and engineering aspects of the proposed project. This information will be made public and used to inform future planning, permitting, and construction of commercial-scale floating offshore wind projects in the region.

Construction activity on the research array is not likely to occur for several years. The lessee is first required to submit a research activities plan to BOEM, which will undergo environmental analysis under the National Environmental Policy Act.

REMUS UUVs for GOM Seafloor Mapping

HII's Mission Technologies division has successfully built and delivered two REMUS 620 UUVs to NOAA for enhanced high-resolution ocean floor mapping. REMUS 620 is the first medium-class UUV designed to deliver a comprehensive range of above- and below-water capabilities over long distances, according to HII.

NOAA plans to use the REMUS 620 vehicles in the Gulf of Mexico (GOM), with a focus on restoring mesophotic and deep benthic communities (dim and sunlight-free seafloor habitats) injured by the 2010 Deepwater Horizon oil spill. The timely delivery of these UUVs will enable NOAA to accelerate its critical environmental restoration and exploration missions, building on its existing use of other REMUS models for habitat characterization, marine archaeology, and various oceanographic studies.

\$62 Million to Fund Clean Hydrogen Tech

The U.S. Department of Energy (DOE) has announced nearly \$62 million for 20 projects in 15 states to accelerate the research, development, demonstration and deployment of clean hydrogen technologies. These projects will advance critical elements of hydrogen fueling infrastructure; develop and demonstrate hydrogen-powered container-handling equipment for use at ports; and improve processes essential to the efficient, timely and

equitable deployment of hydrogen technologies.

Among the selected projects are innovative, first-of-a-kind efforts to improve community engagement and ensure the benefits of the clean energy revolution are felt by all Americans. DOE's Hydrogen and Fuel Cell Technologies Office (HFTO) will manage the selected projects, which span the following five topic areas: Components for Hydrogen Fueling of Medium- and Heavy-Duty Vehicles (four projects, \$8.5 million); Standardized Hydrogen Refueling Station of the Future (four projects, \$40 million); Hydrogen Fuel Cell-Powered Port Equipment (one project, \$2.5 million); Enabling Permitting and Safety for Hydrogen Deployment (seven projects, \$7 million); and Equitable Hydrogen Technology Community Engagement (four projects, \$4 million).

High-Performance Computing System for NOAA

One-hundred million dollars in funding from the U.S. Bipartisan Infrastructure Law and Inflation Reduction Act has been awarded to General Dynamics Information Technology for NOAA's newest high-performance computer (HPC) system, called Rhea.

Rhea will advance research on weather, climate, ocean and ecosystem prediction. It will be installed in a new modular facility as part of the NOAA Environmental Security Computing Center (NESCC) in Fairmont, West Virginia. NESCC currently houses the Hera HPC.

Rhea features graphics processing units that will accelerate NOAA's use of AI/ML in monitoring marine life species; weather forecasting; and modeling of specific environmental phenomena, such as atmospheric rivers, fire weather and hurricane intensification using Earth observations. The new computing capacity will also be used for weather and climate model development to improve drought, flood, and wildfire prediction and forecasting.

Rhea will be part of NOAA's Research and Development HPC System, which includes four other research and development HPC centers.

Nova Scotia Marine Renewable Energy Bill

Nova Scotia has passed Bill 471, the Advancing Nova Scotia Opportunities Act, legislation to enable offshore wind and tidal energy developments to contribute to achieving the province's clean electricity and net-zero goals, according to Marine Renewables Canada.

The legislation includes amendments to the Marine Renewable-energy Act and the Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act to help Nova Scotia stay on track for its goal of 5 GW of offshore wind leases by 2030 by: creating the ability to delegate ministerial power or duty to other entities; allowing planning tools in addition to strategic environmental assessments, such as regional assessments, to help identify areas for offshore wind development; and adding authority to develop regulations.

Amendments to the Marine Renewable-energy Act also enable tidal energy developers to split an existing license into two or more licenses. This increases options for industry to plan and deliver projects while aligning with environmental protection regulations. **ST**

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Unmanned Rescue Vessel



GUARDIAN adopts Zelim's type-approved SWIFT recovery conveyor system to lift conscious and unconscious casualties from the water. GUARDIAN also incorporates Zelim's ZOE intelligent person-in-water detection system to optimize rapid search and rescue operations. The vessel can be deployed via existing launch and recovery systems. Zelim Ltd.

Shackle for Lifting

Link-It Max is a high-performance soft shackle designed for lifting applications. Rounding out the popular Link-It family of products, Link-It Max is a button-knot soft shackle made with Samson's flagship Amsteel Blue 12-strand rope and durable chafe jacket with unique secondary locking mechanism. Samson Rope Technologies.

LNG Carrier ML Simulator

Designed to maximize efficiency by bridging the gap between LNG carrier commercial and operations teams, this simulation suite enhances collaboration between charterers and owners, addressing key segment challenges through advanced simulation and data analytics to unlock new insights for collaboration, decision making, and negotiation. It has the potential to save more than 100 MT of LNG per voyage and an estimated \$360,000 per vessel per year. Danelec A/S.

Onboard Data Gateway

eSync is designed to meet the evolving cybersecurity needs of the global shipping industry by eliminating the need for physical AVCS

media, such as DVDs and USB sticks, on vessels, thereby removing the necessity for manual data transfers to the bridge. Once installed and connected to the vessel's communication system and the bridge's ECDIS, regardless of brand, eSync significantly streamlines the data upload and management process and minimizes the risks associated with manual handling. ChartWorld GmbH.

Offshore Wind Chain Crane



The Eye Catcher is a high-speed, chain-driven davit crane combined with a self-engaging crane hook for offshore wind turbine maintenance. To lift loads or sensitive goods quickly, efficiently and safely, the standard capacity of this chain crane is 1 tonne at a radius of 3.5 m. It can lift up to 3 metric tonnes and can be supplied with a heave compensation mode. The Breman Group.

Asset Compliance Management

"MOVE by Bureau Veritas" is a smart hub for shipowners that integrates various maritime digital applications, helping reduce operational complexity by enabling fast, informed decision making on asset compliance and performance. The streamlined classification experience enables management of fleets throughout their life cycles and analysis of data from a single interface. Users can manage their assets throughout early design, construction and operation. Bureau Veritas Marine & Offshore.

Wind-Assisted Propulsion

The WindWings portfolio has expanded with the launch of the 20- and 24-m models, designed to save 0.7 tonnes of fuel per day per WindWing on average on world-wide routes. Building on the global success of the 37.5-m WindWings, these new models are suitable for handysize bulkers, chemical tankers and other smaller ships. They apply to newbuilds and retrofits. BAR Technologies.

Dry-Bay Optical Sensor



A dry bay version of the RBRtrident three-channel optical sensor is now available. It can make multiple fluorescence and backscatter measurements simultaneously at a depth rating of 1,250 m. Parameters currently available include: chlorophyll a, fDOM, phycocyanin, phycoerythrin, backscatter and turbidity. Users can select a combination of any three of these parameters when ordering. Additional wavelengths are available on request. RBR Ltd.

Fiber-Optic Splice Kit

The kit ensures a waterproof splice while terminating each end of a cable, making it secure even in the harshest environments. The kit can be installed anywhere along a cable to create a highly reliable, full-ocean-depth splice, with multiple levels of sealing protection. PMI Industries Inc.

Weather Station

The ResponseONE-PRO is all-in-one weather station that allows users to easily access the internal weather sensors and filter for quick, convenient, and cost-effective maintenance. The station enables users to gather wind speed and direction, temperature, humidity, and

pressure accurately and reliably from a single source with minimal footprint. Add-on options include a compass and precipitation gauge. R.M. Young Co.

Hotwater Suit

Evolution 8 is for commercial divers working in extreme conditions. Its advanced internal water distribution system ensures even heating and maintenance of optimal body temperature in cold-water environments. The suit features pre-bent arms and legs for improved mobility, as well as reinforced knee and elbow pads to provide extra durability in high-wear areas. Evolution 8 is built from abrasion-resistant materials. Northern Diver International Ltd.

Workboat Availability Platform

This platform provides a seamless solution for chartering regional workboats on the spot market in a digital environment that allows participants to maintain optional anonymity. By offering workboats

only in an 800-nm radius, significant time and fuel savings are made when deploying vessels on the spot market. Nauticworx.

Ammonia Fuel System

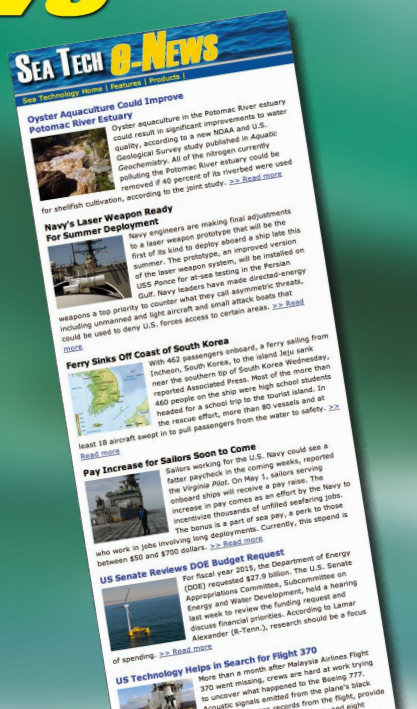
Suitable for both two-stroke and four-stroke engines, as well as other ammonia consumers, the Ammonia System features safety measures that include: gas and leak detection, ammonia capture, reliquefaction, and ammonia release mitigation. The system will facilitate the energy transition and support the shipping industry in meeting its decarbonization targets. Auramarine Ltd.

Under-Ship Data Collection

The EM-2S is designed to be mounted on vessels below the waterline to provide communications for advanced monitoring. Unlike traditional wireless networks, CSignum's patented electromagnetic field signaling enables underwater sensor data to be communicated to networks above the water surface. CSignum Ltd. **ST**

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White Paper on Batteries For Deep-Sea Shipping

CIMAC and the Maritime Battery Forum has published the first of three white papers on the environmental impact of batteries in deep-sea shipping: <https://shorturl.at/e8G7H>.

The paper offers a comprehensive examination of use cases and application areas in this field, demonstrating that there is still potential for battery usage within the industry to support decarbonization. While it is evident that a fully battery-powered, zero-emission application is not available, battery usage may be enhanced by the rise of alternative fuels, depending on needs based on changing design and sizing choices.

The upcoming paper on regulation, safety and impact on staff is expected to be published by the end of 2025. This will be followed by the third paper, which will address the

main topics of energy storage and integration, including life cycle assessment, operation range and limits.

ePropulsion Expands

ePropulsion has established a new business unit: ePropulsion Commercial.

Established in 2012 at the Hong Kong University of Science and Technology, ePropulsion develops marine electric propulsion systems. With a decade of innovation, ePropulsion has expanded into the commercial marine sector, offering comprehensive system integration solutions, both electric and hybrid, for applications ranging from 50 to 1,000 kW.

ePropulsion Commercial provides system integration solutions, including: electric propulsion and electronic control systems, energy storage systems, DC bus technolo-

gy, power and energy management systems, charging solutions, and automation and intelligent technology. These solutions are highly flexible and scalable for the functional requirements, speed, range, and shore power conditions specific to different vessel types.

Collaboration for Autonomous Vessel Systems

Avikus, an innovator in autonomous navigation technology, and DNV have officially announced their collaboration on the development and approval of autonomous vessel systems. This collaboration is a significant step forward as Avikus progresses through DNV's System Qualification process for its autonomous navigation system, HiNAS Control, under DNV-CG-0264 and relevant international standards.

The goal is to achieve the world's first type approval of its kind by the end of this year, setting a new global standard in the maritime industry.

The HiNAS Control system is a standard specification for all HD

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Hyundai newbuilds. The system integrates artificial intelligence (AI) and sensor fusion to merge data from various navigation tools and augmented reality (AR) to assist navigators. This technology enables ships to autonomously avoid collisions while maintaining optimal routes and speeds, thereby reducing navigator fatigue and contributing to safer voyages, better fuel efficiency, and fewer maritime accidents and emissions.

Collaboration for Engine Data

Helm Operations and Caterpillar Marine are combining Helm CONNECT's fleet management software and Caterpillar's engine technology to enable informed decision making and operational efficiency for clients.

The new collaboration addresses the maritime industry's increasing demand for accurate and real-time engine data. By integrating Caterpillar's engine data into Helm CONNECT, operators gain access to crucial information, such as engine hours and fuel burn data, directly within the Helm CONNECT platform. This supports proactive decision making and empowers operators to make informed choices. It also enhances maintenance schedules, boosts fuel efficiency and ensures compliance with environmental regulations, empowering operators with comprehensive, data-driven insights.

Open Data Platform

NOAA and Esri will create the prototype for a one-of-a-kind, fully interoperable open data platform to provide equitable, actionable, and ready-to-use ocean and coastal data for decision makers and communities. The platform will leverage NOAA's massive stores of world-class data with Esri's geospatial technical innovations and capabilities to help users address critical issues with information tailored to their needs.

Currently, vital ocean and coastal data exist across a patchwork of disconnected sources and can require significant translation before use by stakeholders.

The prototype ocean and coastal data hub demonstration project will turn big, potentially overwhelming amounts of data into local-issue-relevant information, such as conservation planning or renewable energy siting.

The hub will provide a proof of concept for harnessing NOAA data and translating them into actionable knowledge. It will also serve as a key component in the development of cross-sector partnerships

and collaborations among ocean community organizations, NGOs, academia, and the private sector to identify gaps in understanding and initiatives.

The end goal is to design an ocean and coastal data information system that not only can show users where to go to access data but also inform users on how best to interpret and use that data. Visitors will be able to find answers to wide-ranging questions. **ST**

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Buoys to Monitor Beach Water

Iknaia is collaborating with OSIL and UnifAI Technology to deliver real-time monitoring of bathing water conditions at Bournemouth and Boscombe beaches in the U.K. for environmental monitoring and public health protection. The consortium is deploying two state-of-the-art water quality monitoring buoys, commissioned by Iknaia and engineered by OSIL. These advanced buoys are equipped with multiple sensor arrays capable of detecting a wide range of pollutants, including *E. coli*.

The real-time data collected by the buoys will be integrated into the UnifAI Technology platform. Over time, UnifAI Technology's advanced AI capabilities will provide predictive water quality information and generate risk indicators for harmful bacteria, ensuring year-round safety for beach-goers.

In addition to water quality metrics, the system will also analyze air quality, wind and weather data through the Iknaia platform.

The data will be publicly accessible via the SeaCheck WebApp. This will enable residents, visitors, and local businesses to make informed decisions about beach visits and water activities.

GOM 'Dead Zone' Survey

NOAA-supported scientists have announced that this year's Gulf of Mexico (GOM) "dead zone"—an area of low to no oxygen that can kill marine life—is approximately 6,705 sq. mi. (an area roughly the size of New Jersey). This is the 12th largest dead zone on record in 38 years of measurement.

Scientists at Louisiana State University and the Louisiana Universities Marine Consortium (LUMCON) led the annual dead zone survey in July aboard the LUMCON RV *Pelican*. This annual measurement is a key metric that informs the collective efforts of the Mississippi River/Gulf of Mexico Hypoxia Task Force, a state/federal partnership that has set a long-term goal of reducing the five-year average extent of the dead

zone to fewer than 1,900 sq. mi. by 2035.

While the NOAA-supported research surveys provide a one-time snapshot of the dead zone, the five-year average captures the dynamic and changing nature of the zone over time. The five-year average size of the dead zone is now 4,298 sq. mi., more than two times larger than the 2035 target.

NOAA scientists are also investigating the feasibility of using ASVs to map hypoxia in the Gulf of Mexico. This year, several ASVs were deployed in coordination with the measurement survey, which will be compared with the ship-based measurements.

Micro-AUV Trials in Madeira

During a recent deepwater trials campaign in Madeira, an ecoSUBm25-Science AUV was launched and successfully completed a spiral behavior to provide vertical profiling of the water column down to 2,000-m depth and back again.

The ecoSUBm25-Science AUV is based on the affordable ecoSUBm-series AUV platform. It weighs just 12 kg and is depth-rated to 2,500 m.

The ecoSUBm25-Science AUV was equipped with a CTD and a Chelsea Technologies TriLux sensor, providing measurements of conductivity, temperature, chlorophyll, turbidity and phycoerythrin. Launch and recovery was from a fast RIB research vessel, provided by the Oceanic Observatory of Madeira.

Metocean Survey for Natural Gas Pipeline in Canada

ASL has recently completed a six-month metocean survey for FortisBC Energy Inc. as part of its ongoing operations and maintenance activities supporting its stewardship of the Vancouver Island Transmission System that supplies natural gas to Vancouver Island and the Sunshine Coast. Wave buoys and subsea current profilers were deployed from December 2023 to June 2024, with a mid-program servicing trip in

March 2024. All subsea equipment and wave buoy mooring anchors were successfully recovered, with full recovery of all data sets.

The field program measured directional waves and subsea currents at six individual moorings deployed at three strategic locations along the pipeline route in the Strait of Georgia near Powell River, British Columbia, and Texada Island. These measurements utilized ASL's new PBM-15 polyethylene deepwater buoys to support data collection in water depth to 400 m.

The data sets collected from this program will be used in numerical modeling studies to support pipeline spanning and integrity assessment at various locations, to be conducted by Worley and RPS, a Tetra Tech Co.

Bioreactive Iron Feeds Ocean Phytoplankton

U.S. scientists have measured the relative amounts of bioreactive iron in four sediment cores from the bottom of the Atlantic, collected by the International Ocean Discovery Program and its earlier versions, showing for the first time that the further dust is blown from the Sahara, the more iron in it becomes bioreactive through chemical processes in the atmosphere.

The results suggest that during long-distance atmospheric transport, the mineral properties of originally non-bioreactive, dust-bound iron become more bioreactive. This iron then gets taken up by phytoplankton.

Rather than focusing on the total iron content as previous studies had done, this study measured iron that can dissolve easily in the ocean and can be accessed by marine organisms for their metabolic pathways.

The scientists conclude that dust that reaches regions such as the Amazonian Basin and the Bahamas may contain iron that is particularly soluble and available to life. This is because of the great distance from North Africa, which allows for longer exposure to atmospheric chemical processes. The transported iron seems to stimulate biological processes. **ST**

Underwater Solutions for Italian Navy

MacArtney has been selected to deliver critical underwater systems that bolster the security, safety, surveillance, and rescue efforts of the Italian Navy's Special and Diving Operations - Submarine Rescue Ship (SDO-SuRS) contracted to Italian shipbuilder T. Mariotti.

The solution comprises MacArtney's electric launch and recovery system, eLARS, and advanced technology from business partners Klein, AML Oceanographic, and Sonardyne, providing high-resolution side scan sonar, moving vessel profilers, and diver detection sonar systems.

The technologies improve the vessel's launch and recovery, security, and surveillance capabilities. They also strengthen safety measures by enhancing the detection of unauthorized divers and vessels, tracking movements, and improving underwater imaging.

Harbor Tug for Lithuanian Navy

Damen has signed a contract with the Lithuanian Defence Resources Agency for the acquisition of a new ASD Tug 3010. The tug is to be delivered to the Lithuanian Navy within nine months.

The harbor tug will significantly contribute to the Lithuanian Navy's ability to perform various tasks. This includes a wide range of missions related to host nation support for visiting allied ships and reinforcement movement through the Port of Klaipeda, ensuring port security and supporting the execution of tasks by the naval fleet and other units in the Navy.

The tug will be the first newly built vessel to be included in the naval flotilla. Previous acquisition projects involved obtaining and modernizing vessels from NATO countries to suit the needs of the Lithuanian Navy.

Hydrographic Survey Solution for UK MoD

A containerized remotely operated towed vehicle (ROTV) solution, developed for the U.K. Ministry of Defence (MoD), has successfully completed factory acceptance tests just six months after the contract was awarded to Danish subsea engineering specialist EIVA.

Through containerization, this new type of survey solution enables hydrographic surveys with multiple acoustic survey sensors and instruments to be performed from many different host platforms with very short deployment time.

The components of this survey solution include SH Group's 20-ft. Cube container module and launch and recovery system for EIVA's ScanFish L ROTV, which is equipped with Sonardyne's SPRINT-Nav Mini hybrid INS/DVL and Voyis's Observer Pro optical camera and Insight Pro laser scanner. Two dedicated computer workstations are built into the container and equipped with EIVA's NaviSuite software for efficiently processing and analyzing the collected data.

EIVA is working with Forcys, a global maritime defense company and EIVA's sister company in Covelya

Group, to ensure the solution aligns with the current requirements of navies for portability, flexibility, scalability and standardization.

CFRB Training for Montenegro Navy

Silver Ships, a manufacturer of workboats, has completed reactivation and crew familiarization training on four Coastal Fast Response Boats (CFRBs) that were recently delivered to the Montenegrin Navy. Training took place over two weeks.

The CFRBs will be used for coastal and harbor patrol, as well as law enforcement interceptor vessels patrolling Montenegro's 183 mi. of coastline along the Adriatic Sea. The large, fast cabin vessel amplifies the features of Silver Ships' popular *Endeavor* and *Ambar* series of vessels.

The four custom-designed military CFRBs feature specialized communications and navigation equipment. The durable, 46-ft. deep-vee hull vessel features a cabin and WING collar system. The boats are powered by twin Caterpillar C7.1 500-hp marine diesel engines and Hamilton HJX-29 waterjets. The engines were supplied by Thompson Marine.

Amphibious Multi-Ship Procurement Contracts

HII's Ingalls Shipbuilding division has been awarded a \$9.6 billion multi-ship procurement contract for the construction of three *San Antonio*-class (LPD-17) amphibious ships and a contract modification for the next *America*-class (LHA-6) large-deck amphibious ship. **ST**

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Decom Systems for Australia

Sentinel Subsea has installed WellSentinel systems for two projects in Australia.

One project saw Sentinel Subsea selected by a client to support the decommissioning of subsea assets in collaboration with Baker Hughes. This project deployed two WellSentinel Coral systems that enable the continuous monitoring of temporarily suspended wells in a remote field. The systems were installed onto two wellheads from a vessel of opportunity, ensuring a streamlined operation that required no in-well intervention.

For another client, Sentinel Subsea deployed two WellSentinel Coral-Frond Hybrid systems designed to monitor two suspended wells, featuring a Coral design enhanced with a Frond-type gathering structure. This enhancement allows for monitoring an area approximately 5 m external to the wellhead.

Components for both projects were manufactured locally by Scope Engineering through ongoing collaboration, while other passive monitoring elements were shipped from Sentinel's headquarters in Aberdeen to Australia.

Ammonia Fuel Conversion For OPSV

Wärtsilä will supply the equipment for the conversion of an offshore platform supply vessel (OPSV) to operate with ammonia fuel for Norwegian shipowner Eidesvik. The vessel, *Viking Energy*, which is on contract to Equinor, is scheduled for conversion in early 2026 and is expected to start operating on ammonia in the first half of 2026, becoming the world's first ammonia-fueled in-service ship.

Equinor is contributing financing for the conversion. Wärtsilä will supply the engine and complete fuel gas supply system and exhaust after-treatment for the conversion. This is the first vessel to use Wärtsilä's ammonia solution.

Ammonia has emerged as a promising alternative fuel as the

shipping industry looks for more sustainable fuel options. With new global regulations having set a target of net-zero emissions from shipping by mid-century, ammonia will play a significant role.

Akselos and Shell Expand Partnership

Akselos, a provider of structural performance management (SPM) software, has made a strategic enterprise agreement with Shell Information Technology International B.V.

The new agreement between Akselos and Shell will extend successful projects with Shell Pearl GTL in Qatar, Shell Scotford in Canada, the Bonga FPSO and various deployments in the Gulf of Mexico. The new agreement aims to expand Akselos' footprint across the entire Shell enterprise, making Akselos Shell's primary partner for structural performance management.

Under this agreement, Shell will leverage Akselos' SPM software to monitor the structural health of critical assets across the Shell portfolio in near real time. Akselos' SPM software will enable Shell to optimize the life cycle of critical assets safely and sustainably.

Mark Marine Collaborates With BERG Propulsion

The United Arab Emirates-based shipyard Mark Marine is collaborating with BERG Propulsion to use BERG Rotordynamics Services for Mark Marine's project to deliver eight vessels to Rawabi Vallianz Offshore Services for one of the largest build projects in the Middle East.

Customization steps during the project have included a request to BERG to deliver supplementary on-site Rotordynamics Services. During the installation of the first high-value asset in the series, collaboration with BERG simplified the shaft alignment calculation process and eliminated complexity.

Mark Marine also trained its staff to secure the necessary skills to replicate alignment procedures on the remaining vessels. BERG Propul-

sion's on-site technical expertise is expected to result in cost savings and faster installation throughout the project.

Growing complexity of onboard systems and new innovations in technology have brought a pressing need for closer collaboration between propulsion solution providers and shipyards.

If shaft alignment is not optimized, it presents a risk for the ships in operation.

Working with yards, Mark Marine adds BERG's Rotordynamics Services expertise to its company experience and knowledge to create a synergy that mitigates risk, avoids premature equipment failure, and extends a ship's life cycle.

Services cover monitoring, detection and correction across a wide range of vessel types; tracking excessive vibrations and premature parts failure that can indicate shaft misalignment; basic anomaly identification and resolution; breakdown/failure resolution; and investigation with bespoke solutions for complex problems.

Sustainable Offshore Terminal To Reduce Carbon Emissions

Vaholmen and SafeSTS have signed a memorandum of understanding to develop a sustainable offshore terminal that will provide opportunities to reduce the carbon footprint of their customers.

By bringing the transshipment terminal closer to the operating fields, not only will it save fuel and emissions, it will also provide a means of recovering and monetizing the volatile organic compound (VOC) emissions generated by an export tanker during cargo transfer operations.

The TVB Vaholmen Offshore Terminal will comprise two main elements: the transfer via buoy (TVB) and the Vaholmen unit.

The TVB enables conventional tankers to moor to it as if it were a calm buoy, while a dynamic positioning tanker stations itself close to the buoy to transfer oil via hose strings attached to the same buoy.

The Vaholmen Unit includes the VOC recovery plant installed on a dynamically positioned vessel. **ST**

contracts

ABB, Helsinki, Finland, has secured a contract for the integrated power and propulsion system on board a highly advanced cable-layer vessel. The order includes the Onboard DC Grid power distribution system, Azipod electric propulsion, and Power and Energy Management System. NKT.

Eco Marine Power Co. Ltd., Fukuoka, Japan, has signed a cooperation agreement in the United Arab Emirates for projects that will include the implementation of ship solar power systems, data management systems and energy-saving technologies. This agreement covers installation services, system testing, electrical engineering design and after-sales support. Aries Marine and Engineering Services LLC.

Wärtsilä, Helsinki, Finland, has been awarded the prototyping tender for the revolutionary Next Generation Vessel Traffic Management System project. This initiative is set to transform maritime safety and efficiency at one of the world's busiest ports. Maritime and Port Authority of Singapore.

3t Drilling Systems, Dorset, U.K., has a new agreement for the provision of its drilling and well control simulation technology, the Drill-SIM:6000, to the Institute of Drilling Technology in Dehradun, India. Oil and Natural Gas Corp.

Lynker, Leesburg, Virginia, has been awarded a \$7.5 million contract to provide up to five years of operational and training support for uncrewed systems for hydrographic mapping and fisheries missions. NOAA's Uncrewed Systems Operations Center.

The Nippon Foundation-GEBCO Seabed 2030 Project, London, U.K., has added partners to the global seafloor mapping effort. One is a company dedicated to transforming ocean exploration through

the use of artificial intelligence (AI). The other company specializes in robotics, navigation and subsea imagery solutions. SeaDeep and Exail.

DNV, Oslo, Norway, has signed a memorandum of understanding to fast-track the development and approval of autonomous and remote-controlled shipping technologies for a safer, more efficient industry. Navigation Brilliance.

Alfa Laval, Lund, Sweden, has received an order to replace 18 ballast water treatment systems on board vessels belonging to a major European shipowner. Undisclosed.

Svitzer, Copenhagen, Denmark, has signed a contract with a Turkish shipyard to build a world-first battery-methanol tug. The tug will be based on Svitzer's innovative TRAnverse tug design and feature a 6-MWh battery supported by dual-fuel methanol engines for backup and range extension. Uzmar.

OceanWise, Alton, U.K., has been awarded a contract to provide comprehensive maintenance, servicing, and emergency call-out services for the South Wales ports of Cardiff, Newport, Swansea, Port Talbot, and Barry. Associated British Ports.

Greensea IQ, Richmond, Vermont, has selected a subcontractor and sales representative for EverClean, its hull-cleaning service, in Louisiana, including at the Port of New Orleans. Baker Marine Solutions.

Exail's, Boston, Massachusetts, Phins Compact C7 INS has been selected to upgrade a deepwater AUV fleet. The INS delivers survey-grade navigation at depths down to 6,000 m. The Monterey Bay Aquarium Research Institute.

Havfram, Hamburg, Germany, has signed a contract with an independent German asset manager of clean energy infrastructure projects for the transport and installation support of wind turbines for the Waterkant offshore wind farm in the German North Sea. The contract

covers 16 of the foreseen 18.5-MW turbines. Luxcara. **ST**

meetings

DECEMBER

December 9-13—AGU Annual Meeting, Washington, D.C. www.agu.org/annual-meeting.

December 9-13—Chesapeake Technology SonarWiz Training, Nashville, Tennessee. <https://chesapeakeotech.com/wp-content/uploads/2024/09/2024-12-Workshop-Agenda-1.pdf>.

December 12-13—Marintec Innovation Conference, Shanghai, China. www.marintecchina.com.

2025

JANUARY

January 7-9—Challenge of Science Leadership Training Course, Plymouth, U.K. www.barefoot-thinking.com.

January 15-17—Floating Wind Solutions, Houston, Texas. <https://floatingwindsolutions.com>.

FEBRUARY

February 10-12—Geo Week, Denver, Colorado. www.geo-week.com.

MARCH

March 12-13—European Green Steel Industry Summit, Dusseldorf, Germany. www.wplgroup.com/aci/event/the-european-green-steel-industry-summit.

March 25-27—Undersea Defence Technology (UDT), Oslo, Norway. <https://udt-global.com>.

APRIL

April 8-10—Interspill, London, U.K. www.interspill.org.

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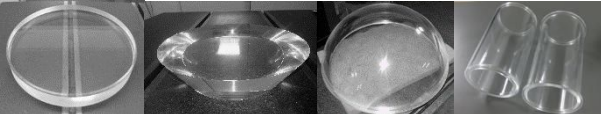
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Raye Montague: A 'Hidden Figure' No Longer — Kelley Stirling

Photo: Raye Montague. Author: Kelley Stirling is the director of corporate communications at U.S. Naval Surface Warfare Center, Carderock



Division. She began her career in the U.S. Navy as active duty and has been working for the Navy for 29 years, mostly in public affairs. The renaming of the Carderock conference center to the Raye Montague Center for Maritime Technology is a highlight of her career.

Earlier this year, U.S. Naval Surface Warfare Center, Carderock Division renamed a building after Raye Montague, a naval icon of computer ship design.

Considered one of the Navy's own "hidden figures," Montague started her naval career as a clerk typist at Carderock, or, as it was known in 1956, the David Taylor Model Basin, located in West Bethesda, Maryland. Later in her career, she was the first person to design a Navy ship using computer-aided software.

As a black woman living in segregated Arkansas in the 1950s, Montague encountered several hurdles that prevented her from pursuing engineering programs in college. Although she had wanted to study engineering, at the time, no colleges in Arkansas permitted such degrees to female African-American students. Instead, she studied business and graduated Arkansas Agricultural, Mechanical and Normal College (now the University of Arkansas at Pine Bluff) with a bachelor's of science in business in 1956. During her time in college, Montague also took night courses in computer programming.

Once at Carderock, she quickly showed her aptitude in science and math, which would eventually lead her to be reassigned to work with the new Universal Automatic Computer I (UNIVAC I) system, the

world's first commercially available computer.

A few years later, she would take on a new position as a digital computer systems operator at the Naval Ship Engineering Center in Hyattsville, Maryland. She was charged with modifying and reconfiguring the massive ship specifications automation system known as Computer-Aided Ship Design and Construction (CASDAC).

When she completed this "impossible task" within her deadline, Montague was eventually asked to design a ship, again with what her bosses thought to be an impossible deadline of one month, after President Richard Nixon said the Navy had two months instead of two years to get it done.

Montague crushed that deadline and is credited with designing the first draft of the *Oliver Hazard Perry*-class frigate in 1971 in less than 19 hr., earning her a Meritorious Civilian Service Award and revolutionizing ship design.

Montague's dream of becoming an engineer was realized later in her career, when she ultimately became the program director for Naval Sea Systems Command's (NAVSEA) Integrated Design, Manufacturing and Maintenance Program. She also served as the division head for the Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) Program. In addition, Montague was the U.S. Navy's first female program manager of ships and the first program manager of information systems improvement.

During the ceremony on February 15, 2024, when Carderock's conference center was renamed the Raye Montague Center for Maritime Technology, Montague's son, Dr. David Montague, the associate vice chancellor for Academic Affairs-Student Success at the University of Arkansas at Little Rock, spoke of his mother's career at Carderock and the Navy.

"My mother started in the Applied Mathematics Lab at Carderock, and she did a lot of her formative, early-career opportunities when she moved from Arkansas—during segregation—to Maryland, and the Navy gave her that opportunity," Montague said. "Although she faced obstacles, like being a woman coming from a state where women were not encouraged to study STEM, she overcame it, and that was special. She built a trusting network at Carderock, which is important because that team building and that effort to make a difference is what laid the ground work for her to become the first female program manager of ships. She opened doors for other people."

Montague's career is displayed in the lobby of the Raye Montague Center for Maritime Technology, where visitors will be able to learn about her life and career.

While Montague's accomplishments contributed to the rapid development of computer-aided ship design, she still continued to face hurdles throughout her career, especially in a field dominated by men. But, despite those hurdles, she was always proud of her time working for the Navy and her accomplishments in the ship design industry.

Now, at Carderock and beyond, computer-aided modeling practices are common and being used to design future ships and submarines. The most active current incarnation is the Department of Defense's High Performance Computing Modernization Program's Computational Research and Engineering Acquisition Tools and Environments (CREATE) Ships project, designed to improve the Navy's acquisition process with the development of software tools to help generate and process design options.

Montague broke boundaries in her career, and her legacy continues to be the foundation of the U.S. Navy's modern ship design work. **ST**

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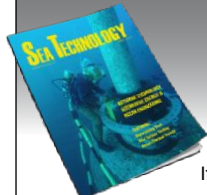
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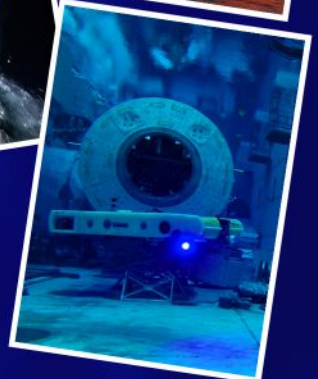
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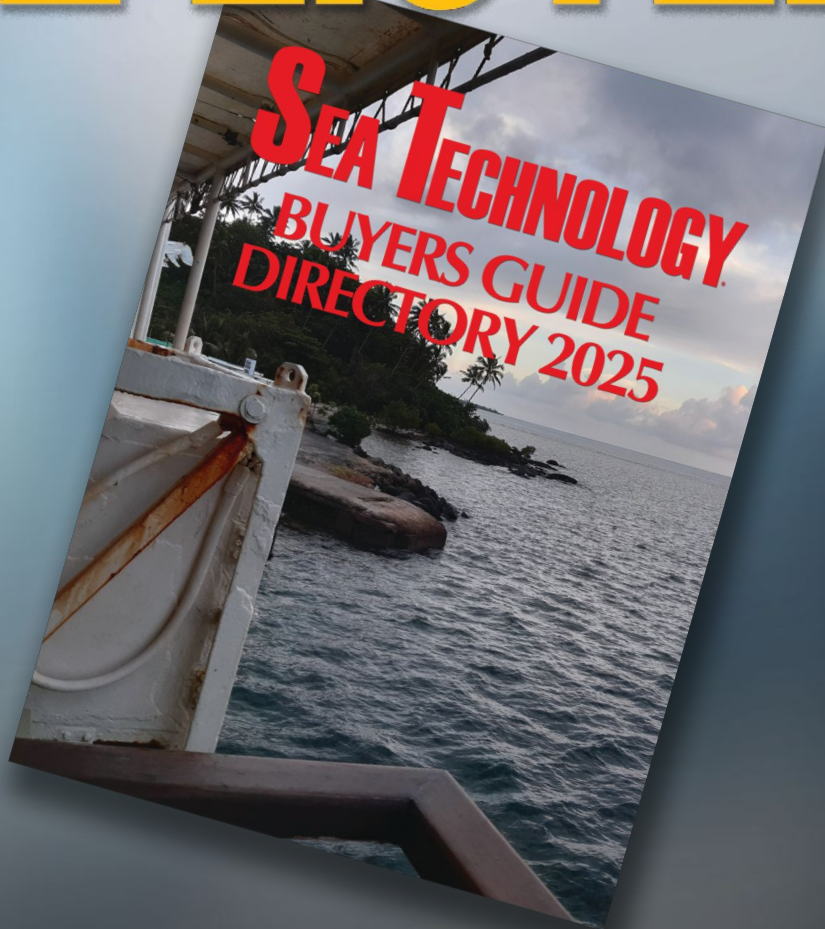
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