

## A NOVEL FORCE – INTEGRATING UNDERSEA, SUBSEA, AND SEABED CAPABILITIES IN DISTRIBUTED MARITIME OPERATIONS

# UNDERSEA WARFARE DIVISION



**RDML KEVIN BYRNE**  
Commander,  
NAVSEA Warfare Centers

## SPRING 2021 UNDERSEA WARFARE VIRTUAL CONFERENCE

### The NAVSEA Warfare Centers' Long Range Research and Development Plan: A Multi-Faceted Approach to Technical Excellence

By: RDML Kevin Byrne, Commander, NAVSEA Warfare Centers  
Dr. Brett Seidle, Executive Director, NAVSEA Warfare Centers

The accelerating pace of technological change makes it imperative that the Navy research and development enterprise adopt new processes and methods. The Naval Sea Systems Command (NAVSEA) Warfare Centers, which include both the Surface and Undersea Divisions, have developed and adopted several new approaches to ensure that the workforce has the tools—including infrastructure—and training to identify current and future technologies that will have the most significant military impact. This new approach is comprised of several diverse efforts, all with the goal of developing a complete and comprehensive science and technology strategy. To address near- and mid-term needs, the NAVSEA Warfare Centers have identified a set of knowledge points and knowledge point champions, who are experts within the enterprise to foster the development of requisite science

and technology associated with specific knowledge areas. The Long Range Research and Development Plan (LRRDP) is the mechanism by which the NAVSEA Warfare Centers examine the landscape for science and technology developments that will provide revolutionary far-term warfighting capability.

Knowledge points, which span a number of emergent technology areas, are central to focusing the NAVSEA Warfare Centers' science and technology investment strategy. For example, advanced autonomous systems are fundamental to this effort, so the NAVSEA Warfare Centers continue to invest in the military applications of autonomy, artificial intelligence, and machine learning, incorporating commercial breakthroughs, as applicable, to gain military advantages. Other high-interest research areas include intelligent autonomous systems, modeling and simulation capabilities, as well as reliability, durability, and maintainability for low-cost and expendable systems.

Integrated power and energy sciences represent another broad technical area that is fundamental to nearly all systems but particularly important for long-endurance unmanned systems.



**DR. BRETT SEIDLE**  
Executive Director,  
NAVSEA Warfare Centers

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Specific research areas include power generation, distribution, high-density power-systems protection, energy storage, controls, thermal management, and assessment of phenomena associated with these areas, both physically and via modeling.

Ocean sciences and sensing constitute an additional knowledge point that the NAVSEA Warfare Centers continue to invest in to better understand and predict the dynamic evolution of ocean phenomena and processes as they affect the performance of naval systems. Applying ocean science research to maritime operations requires rigorous interdisciplinary efforts that integrate evidence-based, multimodal analyses and effectively employ systems thinking to understand complex processes. Collaborating with the Office of Naval Research, the NAVSEA Warfare Centers seek to increase the number of technical personnel with advanced degrees and training in both oceanographic sciences and naval systems.

A recent addition to the set of knowledge points is the emergent application of quantum sciences to naval capabilities. Recent breakthroughs in quantum computing are beginning to show applications beyond the research laboratory. Research areas of interest to the Navy include quantum cryptography and communication; quantum algorithms and computing; quantum sensing; quantum metrology; and quantum energy transport and heat engines.

Future threats and future opportunities will come from the synergistic combination of many of these emerging technologies. Providing a framework to maintain awareness of potentially relevant technologies and fostering discussions about the application of these technologies, the NAVSEA Warfare Centers developed the LRRDP to identify emerging technologies that may impact the detect, command and control, and engage sequence. The LRRDP further investigates the potential future impact on each warfare area (surface, undersea, mine, etc.) and foundational technical areas, such as platform

design and platform mobility. Additionally, consideration is given to which combinations of new technologies will reveal new and perhaps game-changing warfighting capabilities. To facilitate discussions among the NAVSEA Warfare Centers' scientific and technical community, and engagements with industry and academia, technologies are organized into specific "technology domains," including computational sciences, autonomous/intelligent systems, and bio-sciences.

The LRRDP framework has evolved into a tool that serves several purposes: It highlights emerging technologies that impact future warfare and warfighting capabilities; helps serve as a guide for science and technology investments; informs workforce development by identifying required skills; and helps inform investments in facilities and infrastructure. The LRRDP framework has become a key tool in developing a long-term strategy to maintain the NAVSEA Warfare Centers' scientific and engineering excellence, and provide new and potentially game-changing warfighting capabilities.

Both the knowledge point process and the LRRDP consider international as well as domestic scientific and technology developments. Worldwide access to technical data requires that global scientific endeavors must be monitored and assessed to prevent technological surprise. In many cases, cooperation with allies can lead to more rapid and cost-effective deployment of new systems.

The knowledge point process and the LRRDP represent key aspects of the NAVSEA Warfare Centers' approach to ensure that the current and future Navy are provided with the best science and technological tools, yielding the most advanced warfighting capabilities. These efforts represent a comprehensive and continuous methodology addressing both the near and far term, as well as platforms for partnership and collaboration with industry and academia.

## DIVISION CHAIR'S MESSAGE



**MIKE CORTESE**

CHAIR, UNDERSEA WARFARE DIVISION

On behalf of the entire management team of the National Defense Industrial Association's Undersea Warfare Division, welcome to the Spring Conference. To say that the past year has been a challenge with respect to the conduct of our normal classified forums would be a significant

understatement. It was just over a year ago that the world began to experience the widespread effects of the COVID-19 pandemic. Because there wasn't enough time to develop an alternate plan, we were forced to cancel our 2020 Spring Conference.

Fortunately, the rapid growth of virtual event platforms like Zoom and the time needed to pursue a new approach allowed us to conduct the 2020 Fall USW Conference as an unclassified virtual event. With invaluable support from the NDIA, the USW Division Fall Conference Chair, Technical Committee Chairs, and their deputies did an outstanding job planning for and executing this first-of-a-kind virtual conference. Based on the positive feedback we received from surveys of the 603 individuals who registered for the conference, it was clear most agreed the event was a big success.

Of course, as good as the virtual platforms have become, we recognize they just can't replace the value of in-person networking/engagements and we must be able to speak at a classified level to fully understand the Navy's vision, objectives, and plan for maintaining undersea warfare superiority. Although the continuing restrictions associated with COVID-19 required us to conduct this year's Spring USW Conference as a virtual event as well, we are hopeful that widespread vaccine distribution will lead to the conditions necessary for us to conduct this year's Fall Conference on September 27 – 29 as an in-person event in Groton, CT. At least, that is our plan.

The importance and urgency of our USW effort is great.

Growing regional and global threats continue to advance interests, operations, and capabilities that challenge freedom of the seas, nation sovereignty, and many of the freedoms we hold dear. Relationships between non-nation state and nation state actors that hold worldviews counter to our values continue to evolve with uncertain outcomes. Our warfighters need our focus and dedication to develop the capabilities they require to succeed and preserve our way of life.

Over the past decade, Navy and Defense Department leaders have consistently articulated the need to maintain our USW advantage. Most recently, the Future Naval Force Study released in December 2020 calls for a Future Fleet Architecture that requires at least 72 fast attack submarines by 2045. As our military partners outline their plans for more USW platforms, a broad array of new payloads, and the sensors and other supporting elements of a sophisticated network of undersea assets, it is more important than ever that members of government, industry, and academia remain aligned, communicate effectively, and collectively move forward toward the shared goal of ensuring our USW dominance.

A special thanks to all of our plenary speakers, program managers, and technical presenters for taking the time to brief our USW community. While your briefs and the resulting discussions are the reason we are here, the information you provide is critical to our support of the warfighter and the defense of our nation.

On behalf of the Executive Board, the Advisory Council, and NDIA, thank you and your organizations for your continued support of the National Defense Industrial Association, the Undersea Warfare Division, our warfighters, and these conferences. We hope you enjoy this Spring Conference and look forward to seeing you in person at the Fall Conference in Groton.



## NDIA UNDERSEA WARFARE AWARDS



**PIERRE CORRIVEAU, PHD, CHAIRMAN, AWARDS COMMITTEE**

The NDIA Undersea Warfare Division (UWD) Bronze Award is granted to recognize outstanding individual achievements in either Science or Engineering in the field of Undersea Warfare and is awarded to key individuals in the principal Navy and University Laboratories engaged in

Undersea Warfare-related activities. By recognizing these individual achievements, the UWD seeks to:

- Reward achievement in the field of Undersea Warfare;
- Inspire accomplishment by other workers in the field; and
- Increase public awareness of the field and its importance to Defense preparedness.

This Spring's 2021 publication of the NDIA Undersea Warfare Awards provides the summation of previously presented awards that were recognized in the Fall of 2019 and Spring of 2020 and 2021. We are proud to present the achievements of the Fall 2019, Spring 2020, and Fall 2020 awardees as follows.

### FALL 2019 AWARDEES

During the Plenary Session of the Fall 2019 USW Conference in Groton, CT, the following awardees were recognized.

Of significant note, RADM (Ret) John J. Padgett was presented with the Captain George W. Ringenberg Award for his outstanding services and noteworthy contributions as a member of the Undersea Warfare Division.



**DR. LINDA J. MULLEN**

**NAVAL AIR WARFARE CENTER (NAWC), AIRCRAFT DIVISION**

We recognize Dr. Linda J. Mullen for her exceptional technical contributions in the area of non-acoustic undersea sensing technologies for anti-submarine and mine warfare missions. For over two decades, Dr. Mullen has demonstrated superior technical leadership in both the development and demonstration of hybrid lidar-radar technologies for enhanced sensing in degraded visual environments. Dr. Mullen continuously excels in developing successful collaborations with industry, serves in key technical leadership roles across the Department of Defense, and is a skilled mentor within academic communities to help develop the next generation of undersea warfare sensor specialists. These results

have been exemplary and are to be commended and rewarded. Her devotion to duty reflects great credit upon herself and upholds the highest traditions of the Navy and the National Defense Industrial Association.



**DR. J. TORY COBB**

**NAVAL SURFACE WARFARE CENTER (NSWC), PANAMA CITY DIVISION**

Dr. J. Tory Cobb has expanded the U.S. Navy's technical advantage in Undersea Warfare through his exceptional contributions in signal processing, automatic target recognition, and machine learning. As a result of his research, the Navy recently integrated and fielded his side-scan sonar automatic target recognition algorithms into their post-mission analysis software, and recently fielded the software into upgraded Fleet unmanned underwater vehicle systems. Dr. Cobb has been a significant force in advancing the knowledge base by applying machine learning principles to mine warfare. Moreover, his numerous publications in the field have become the basis for future research in this area. His

professionalism, collaborative spirit, and devotion to duty reflect great credit upon himself and uphold the highest traditions of the Navy and the National Defense Industrial Association.



**MR. MICHAEL A. SLATER**

NAVAL SURFACE WARFARE CENTER (NSWC), CARDEROCK DIVISION

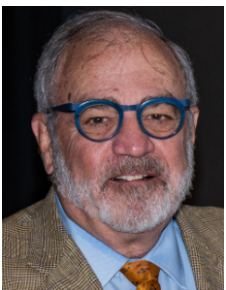
Mr. Michael Slater has contributed to national security and the advancement of critical acoustic measurement technologies in support of the Navy's undersea warfare mission throughout his 34-year career. Mr. Slater has provided exceptional technical insight, engineering execution, and leadership of submarine signature measurement and data collection system development efforts, full-scale submarine test and evaluation trials, acoustic sensor and array design, and fleet operational support. Mr. Slater's detailed knowledge of systems engineering and acoustic signal processing, combined with his insight and technical expertise, have provided the Navy with a robust capability to assess and improve signatures and stealth for over three decades. As a recognized authority on acoustic measurement systems, Mr. Slater's contributions in technology and practices have added to the U.S. dominance in the area of undersea warfare.



**MR. CRAIG J. MADDEN**

NAVAL SURFACE WARFARE CENTER (NSWC), CARDEROCK DIVISION

Mr. Madden's contributions in the area of propulsor and manufacturing technology have directly contributed to the acoustic superiority enjoyed by operational U.S. submarines and the future fleet. His success in integrating new technologies into ship and submarine designs has enabled great advances in acoustic performance. He has contributed a wealth of technical capability and provided manufacturing recommendations informed by decades of insight in propulsor hydrodynamics and hydro-acoustics. Mr. Madden's research into propulsor acoustics and its application to submarine designs have permitted the Navy to achieve enhanced vehicle survivability through increased stealth while simultaneously reducing ship design and lifecycle costs. Mr. Madden's exemplary performance and unwavering dedication to duty have brought great credit upon himself, the Navy, and the National Defense Industrial Association.



**RADM (RET) JOHN J. PADGETT**

FORMER COMMANDER, SUBMARINE FORCE, U.S. PACIFIC FLEET

The Captain George W. Ringenberg Award is presented to those who, through their service and leadership, have made noteworthy contributions to the Undersea Warfare Division.

John Padgett's leadership and dedication to Undersea Warfare has spanned both his naval and civilian service. He held increasingly responsible roles in the U.S. Navy that culminated as the 30th Commander Submarine Force, U.S. Pacific Fleet, where he led our submarine forces in the Pacific in maintaining our nation's undersea dominance. Following his active duty retirement, in 2003, as a Vice President at General Dynamics Electric Boat, he helped improve our submarine forces via life cycle support on our existing boats and the integration of new advanced capabilities on our Virginia-Class submarines. Outside his professional life, he worked tirelessly as a strong advocate for USW, both as the President of the Naval Submarine League, and for the past 14 years, as a member of the NDIA Undersea Warfare Division (UWD). As a UWD Advisory Council member, he continued his advocacy of USW as an active advisor to senior Naval Flag Officers. He promoted the need for the development of a broader USW strategy that encompasses the broad range of different capabilities, systems, and platforms, including intelligence, oceanography, surveillance systems, submarines, and weapons.

As a UWD Advisory Council member, John Padgett contributed significantly to the smooth and efficient execution of the Division's programs. Employing his vast knowledge of USW, coupled with his expertise as both a warfighter and industry leader, he was instrumental in the shaping of the UWD vision. He selflessly devoted his time to provide sage advice and council to conference chairs and the Division chairmen. His actions throughout his career helped our nation achieve and maintain undersea dominance. John Padgett is a consummate professional and upholds the highest traditions of the Undersea Warfare Division. For his outstanding service, leadership and contribution to the Undersea Warfare Division, we recognize RADM (Ret) John J. Padgett with the Captain George W. Ringenberg Award.

## SPRING 2020 AWARDEES

For the 2020 Spring Conference, the Undersea Warfare Division (UWD) of the National Defense Industrial Association (NDIA) was pleased to announce the recipient of the Vice Admiral Charles B. Martell-David Bushnell Award as Dr. Vittorio (Vic) Ricci, Chief Technology Officer, Naval Undersea Warfare Center; the recipient of the Vice Admiral Charles E. Weakley Award as Mr. Robert Simmons, Assistant Program Manager, Underwater Systems PMS 408; and the recipient of the Captain George W. Ringenberg Award as VADM John J. Donnelly, USN (Ret), the former Commander, Submarine Force. In addition, we had the pleasure to announce the recipient of the Rear Admiral Jack Jarabak Award as LT Bryan McDonough for his exceptional contributions in the field of Anti-Submarine Warfare.



### **DR. VITTORIO (VIC) RICCI**

#### **CHIEF TECHNOLOGY OFFICER, NAVAL UNDERSEA WARFARE CENTER**

The VADM Charles B. Martell-David Bushnell Award recognizes exceptional contributions in the field of ASW and/or Undersea Warfare Technology.

Dr. Ricci has developed science and technology roadmaps and strategic planning initiatives, and led numerous forward-looking technology development efforts that have significantly contributed to the Navy's undersea warfare capabilities. He served as Anti-Submarine Warfare Lead for the Defense Advanced Research Projects Agency's Alternative Sensor Study in partnership with Naval Surface Warfare Center Carderock and Dahlgren Divisions, and

led concept development, analysis, and nominal system engineering to study potential solutions for undersea ultra-wide area intelligence, surveillance, and reconnaissance.

Dr. Ricci was Technical Manager for the SPARTAN Scout Advanced Concept Technology Demonstration, which provided unmanned surface vehicles with operational mission capabilities in force protection, anti-submarine warfare, mine warfare, and precision engagement to the warfighter. The SPARTAN project deployed the Navy's first-ever operational Unmanned Surface Vehicle as well as the first-ever Undersea Warfare Combat System as part of the Non-Propulsion Electronic Systems vision. He developed the Transition Plan for SPARTAN into the Fleet and participated in completion of the Navy's first-ever unmanned surface vehicles live-fire tests.

His direct oversight of the Naval Undersea Warfare Center's community outreach programs has assured a cohesive strategy to build the future workforce necessary to sustain and advance the Navy's technical capabilities. Through these and many other important contributions, Dr. Ricci has ensured the advancement of the United States Navy's Undersea Warfare capabilities for many years to come.

For his excellent leadership and unwavering dedication that has significantly benefited our Submarine Force, the Undersea Warfare Division of the National Defense Industrial Association was honored to present this prestigious award to Dr. Vic Ricci.



### **MR. ROBERT SIMMONS**

#### **ASSISTANT PROGRAM MANAGER, UNDERWATER SYSTEMS PMS 408**

The VADM Charles E. Weakley Award recognizes meritorious service and noteworthy contributions to effective government-industry communications in the field of Undersea Warfare.

In his over three decades of service, Mr. Simmons has promoted, advanced, and developed UUV technology, leading to key naval acquisition programs in support of the warfighter. He has labored in the trenches and behind the scenes to make sure that Sailors have the best tools with which to work.

As the PMS 408 Assistant Program Manager for Underwater Systems from 2000 to 2020, Mr. Simmons' work in the field of unmanned underwater vehicles (UUV) is considered the cornerstone on which virtually all current U.S. Navy UUV developmental and operational efforts rest. The systems fielded and maintained under Rob's leadership over the past 20 years have provided transformational capabilities to the U.S. Navy and will continue to influence resourcing, science and technology (S&T), acquisition, lifecycle support, and fleet warfighting capabilities for decades to come.

Over his career, Rob has led acquisition teams and warfighting laboratories in rapidly acquiring, testing, evaluating, and fielding 16 unique, complex weapon systems, including the Mk 18 Mods 1 and 2 UUVs, which are the backbone of expeditionary mine countermeasures (MCM). He provided oversight and management of the government and industry teams that delivered capabilities in multiple underwater mission domains, including the first operational U.S. Navy UUV to conduct MCM missions. These initial UUVs were a vital component of the U.S. Navy's MCM force deployed for Operation Iraqi Freedom (OIF) in 2003 and critical in the execution of clearance operations in the port of Umm Qasr, Iraq.

His efforts have spawned a new generation of experimentation and inspired development of concepts of operations leading to the incorporation of new tactics, techniques, and procedures for operational employment of these systems.

In recognition of his noteworthy contributions to advancing the field of Undersea Warfare and in promoting effective government/industry communications, the Undersea Warfare Division of the National Defense Industrial Association was pleased to present Mr. Robert Simmons with the VADM Charles E. Weakley Award.



**VADM JOHN J. DONNELLY, USN (RET)**

**FORMER COMMANDER, SUBMARINE FORCE**

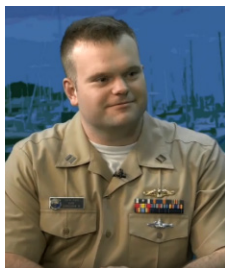
The Captain George W. Ringenberg Award is presented to those who, through their service and leadership, have made noteworthy contributions to the Undersea Warfare Division.

VADM Donnelly has been a positive and powerfully effective force within the NDIA Undersea Warfare Division, exercising great leadership and mentorship since joining the Division's management team following his retirement from active duty. Over his nine years of participation, he has helped lead the Undersea Warfare Division to new levels of excellence and effectiveness by assuring the Division's ability to serve the nation and the Navy in promoting the communications and collaboration necessary to tackle the most challenging aspects of undersea warfare.

VADM Donnelly has frequently tackled emergent issues on behalf of the Division Chair by organizing the efforts of the Advisory Committee and Executive Board. He led the reorganization of the Advisory Committee to be aligned with Division's near-term and long-term goals. In support of the Spring Conference, he set the bar high by always securing a great lineup of flag officers. His suggestions on conference content and format helped improve its effectiveness year over year.

Through his broad participation in the undersea warfare community, VADM Donnelly has helped to ensure that the Undersea Warfare Division's leadership understood important Navy perspectives. These insights helped steer the Division in ways that benefited its participants. His leadership role in the Naval Submarine League ensured that engagement with the League and the Division resulted in effective coordination of events within the undersea warfare community.

The Undersea Warfare Division was proud to recognize VADM John J. Donnelly, USN (Ret), with the Captain George W. Ringenberg Award for his outstanding contributions and service to the U.S. government, the National Defense Industrial Association, and the Undersea Warfare Division.



**LT BRYAN MCDONOUGH, USN**

**NAVAL POSTGRADUATE SCHOOL**

The Rear Admiral Jack Jarabak Award is presented by the UWD in conjunction with the Naval Postgraduate School's Undersea Warfare Executive Committee to recognize a deserving student for their contributions and academic achievements in the field of USW Technology.

For 2019, the award was presented to LT Bryan McDonough, USN, for his personal commitment and academic achievements in the area of Undersea Warfare Technology.

While attending the Naval Postgraduate School from September 2017 to September 2019, you distinguished yourself through outstanding performance in the Undersea Warfare Curriculum. Your exceptional research clearly demonstrates your intellectual ability, analytical skills, and mastery of undersea warfare. As a submarine officer with nuclear power school experience, you brought a unique perspective to your classes as well as your thesis work. Your thesis, "Modeling Submarine Anti-Shipping Warfare in the South and East China Seas," developed a new model to test the feasibility of "War at Sea Strategy" in the South and East China Seas. By testing various search patterns, you found that barrier search is superior when the targets move in predictable paths. Your results are very valuable to fleet operations. Your superior performance in this program strongly indicates your great potential for success in improving our undersea warfare posture.

The Undersea Warfare Division, in conjunction with the Naval Postgraduate School, took great pleasure and welcomed the opportunity to recognize the important contributions of LT Bryan McDonough, USN, by its award of the 2019 RADM Jack Jarabak Bronze Medal Award.



## FALL 2020 AWARDEES

During the Fall 2020 Virtual Conference the following awardees were recognized.

The NDIA UWD was pleased to present Bronze Medal Awards to the following individuals during the Plenary Session of the Fall 2020 USW Conference.



**DR. JASON GOMEZ**

NAVAL UNDERSEA WARFARE CENTER, DIVISION NEWPORT

Dr. Gomez has contributed significantly to several important technical programs, including the Contender Program for the Strategic Capabilities Office and the Underwater Express and Blue Wolf programs for the Defense Advanced Research Projects Agency. The Contender Program will transition into the heavyweight torpedo program of record to deliver both long-range anti-submarine warfare and anti-surface warfare capabilities to the Fleet. For the Underwater Express Program, it will deliver the world's fastest electric underwater vehicle and the first controlled supercavitating vehicle in the United States. This success led to the novel Blue Wolf Program, where Dr. Gomez's work enabled significant improvements in long-range torpedo

and other unmanned underwater vehicle capabilities. The results of his hard work and expertise are evident in the improvement and advancement of essential Navy capabilities for today and the future.



**DR. CHARLES M. LOEFFLER**

APPLIED RESEARCH LABORATORY, UNIVERSITY OF TEXAS AT AUSTIN

Dr. Loeffler's achievements in the USW mission area have focused on research in the area of underwater acoustics. His contributions have included developing specific sonar suites and array geometries to detect difficult targets; investigating and developing efficient processing algorithms that exploit the physical geometry of acoustic arrays as well as the extraction of target characteristics from measured acoustic data; incorporating artificial intelligence and machine learning into U.S. Navy sonar systems; formulating future sonar concepts for UUVs, submarines, and surface ships; and participating in numerous sea tests and exercises onboard U.S. Navy submarines, research vessels, and UUV host platforms. He is equally adept at

performing theoretical developments, modeling and simulation efforts, algorithm developments, performance analyses, or system verification. His keen insight and commitment to the undersea domain has greatly contributed to the continuing advancement of the knowledge base in USW.



**DR. JOSETTE P. FABRE**

NAVAL RESEARCH LABORATORY, WASHINGTON, DC

Throughout Dr. Fabre's successful career, her scientific focus has been to understand and perfect the performance of sonar systems in complex and variable environmental (ocean and atmospheric) conditions. Her work is broad and includes physics-based uncertainty for passive acoustic propagation, compression of ocean fields for transmission to forward platforms, sediment characterization and inversions for geo-acoustic characterization, data assimilation, environmental acoustic sensitivity, reconstruction and analysis, acoustic simulation, and sensor performance prediction. Dr. Fabre's pioneering work in the field of Ocean Acoustic Prediction in Complex Environments has been cited internationally; she is the foremost expert in this area.

Her contributions to computational techniques for ocean acoustic predictions have revolutionized the process by which the Navy determines ocean propagation for passive sonars and leads the way in moving this capability out to forward operational platforms to improve the warfighter's combat effectiveness.





**MR. CHARLES W. KENNEDY**

APPLIED PHYSICS LABORATORY, JOHNS HOPKINS UNIVERSITY

In his 40+-year career, Mr. Kennedy has advanced undersea warfare through the development, test, and delivery of multiple novel acoustic sensor systems. Mr. Kennedy has contributed immensely to the U.S. Navy's use of towed arrays from development to deployment; he has led multi-organizational laboratory and at-sea test and evaluation of several Submarine Advanced Processing Builds; he was a key resource and had direct technical responsibilities for the development of the ground-breaking Large Vertical Array. His in-depth technical knowledge of sonar sensor system development and historical context for system trades continues to guide the development and improved reliability of current and future towed array sensor systems. Mr. Kennedy's contributions to the design and fielding of submarine, surveillance, and surface sensor systems are without equal and directly responsible for technical advantages enjoyed by our fleet.



**MR. FREDERICK J. POPE**

NAVAL UNDERSEA WARFARE CENTER, NEWPORT DIVISION

Mr. Pope's achievements in the USW mission area have established his reputation for achieving high standards, encouraging collaboration, mentoring successors, and providing analysis for delivering advanced systems to the fleet. He has mastered combining theoretical analyses with at-sea experimentation and test exercises. His keen insight and commitment to technological and operational advances in the undersea domain have contributed to the continuing advancement of the knowledge base in USW. His expertise is frequently sought for consultation, advice, and other technical inputs. Through his many years of mentoring and genuine interest in USW initiatives, he has inspired his peers and other workers to excellence. As a recognized subject matter expert in acoustics and strategic assessment, he provides Navy leadership and the acquisition community with information instrumental in numerous trade-off decisions and operational assessments affecting Today's Navy, Tomorrow's Navy, and the Navy After Next.



**MS. DEBRA GROAT**

PROGRAM EXECUTIVE OFFICE, AIR PMA 264

Ms. Debra Groat has led cutting-edge technology projects, evaluations, at-sea experimentations, and planning for future airborne ASW systems at both the tactical and strategic level. She provides superior technical leadership and direction in the development of advanced technologies for ASW mission systems aboard Maritime Patrol and Reconnaissance Aircraft, and her efforts have directly led to ASW capability improvements for both the US and its allies across the entire kill chain. Ms. Groat has helped lead the effort to develop air deployable, multi-static sensor technologies for surveillance activities including Extended Echo Ranging, Multi-static Active Coherent search, Next Generation Airborne Passive Sensor, and Undersea Advantage. Her tremendous drive, technical acumen, and hard work have led to extraordinary advancements in technologies responsible for the success of airborne Anti-Submarine Warfare (ASW). These systems will continue to provide game-changing improvements for the both United States and our allies.

**THE NDIA UWD IS HONORED TO RECOGNIZE THESE SIGNIFICANT CONTRIBUTIONS TO THE UNDERSEA WARFARE COMMUNITY THROUGH OUR AWARDS PROGRAM. CONGRATULATIONS TO THE AWARDEES!**

## NDIA UWD 2020 ACADEMIC SPEAKER AWARD

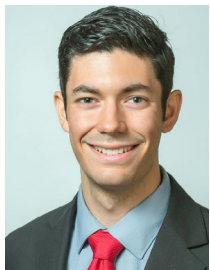


**MARK ROTHGEB**, CHAIRMAN, ACADEMIC FELLOWSHIP COMMITTEE

**DR. MICAH CLARK**, CO-CHAIR, ACADEMIC FELLOWSHIP COMMITTEE

The NDIA Undersea Warfare Division (UWD) established the Academic Fellowship Program in 1990 to provide financial aid to PhD candidates at universities closely associated with the Navy's undersea warfare community. The objective is to encourage outstanding science and engineering students specializing in fields pertinent to undersea warfare to present their research at our conferences. The student candidate pool is derived from the Navy's University Affiliated Research Centers (UARC)s, the Naval Postgraduate School (NPS), and other academic institutions. This Spring, we are pleased to host two academic research contributors from The Applied

Research Lab of the University of Texas and from the Naval Postgraduate School presenting the topics described below.



**James Albritton** is a 2018 graduate of The University of Texas at Austin with a B.S. in Mechanical Engineering. Currently, he is a graduate student in the Walker Department of Mechanical Engineering's Acoustics program at the University of Texas at Austin. His presentation will be covering the construction of a Bayesian inference method for determining seafloor sediment properties from simulated transmission loss data. His study focuses on how these recent inference techniques to reinforce and improve understanding of the seafloor's composition and structure by obtaining sediment bulk parameters and bathymetric parameters through inexpensive in situ acoustic data.



**LT Bridger Smith** is a 2015 USNA graduate with a B.S. in Computer Science. He served onboard USS Nebraska SSBN 739 Gold (GO BIG RED) from 2017 to 2020 before transferring to Naval Postgraduate School to continue his studies. He is currently pursuing a Master's degree in Cyber Systems and Operations. His thesis work, partnered with Project Blue, explores system requirements and prototypes a crew facing interface for their "digital twin." The presentation will cover capabilities of "digital twins" of submarines and the potential uses onboard for maintenance planning. He will also discuss the team's parallel effort to find a path for delivering secure software in a cloud-based, containerized, DevSecOps fashion.

# UNDERSEA COMMAND, CONTROL, COMMUNICATIONS, AND COMBAT SYSTEMS COMMITTEE



**PAUL ROSBOLT**

CHAIRMAN

**DR. BOB ZARNICH**

DEPUTY CHAIR

**JOHN LINDERMAN**

CHAIR, WARFIGHTER PERFORMANCE SESSION

Greetings from my home “office” in beautiful Springfield, VA! Normally, I’d be looking to the unofficial end of Winter with the annual trek to San Diego. Oh well. Hopefully we are back to normal in time for the clambake this Fall! There are some advantages to the online format. Now, everyone will have a chance to see our awesome program managers. During the Day 2 session, we will have CAPT Jill Cesari, Major Program Manager for Undersea Systems, PEO IWS 5.0, CAPT Michael Daigle, Major Program Manager for Submarine Combat Systems, PMS 425, and CAPT David Kuhn, Major Program Manager for Undersea Communications and Integration, PMW 770.

Despite our inability to spend much time in our buildings, a lot of great Combat Systems/C4I work is still going on! Most notably, RADM Doug Small, Commander, NAVWAR, has been stood up as a DRPM for Project Overmatch. From his tasking letter from CNO: “Specifically, you are to develop the networks, infrastructure, data architecture, tools, and analytics that support the operational and developmental environment that will enable our sustained maritime dominance.” He will develop the Naval Operational Architecture (note the term “Naval” rather than “Navy”) that will link all of our platforms together in a tactical grid. Exciting stuff!

On a more local level, our NAVSEA and NAVWAR program offices continue their great work. Here are some highlights from IWS 5.0:

PEO IWS 5.0’s mission is to develop, deliver, and sustain

ASW capabilities to dominate the undersea domain through exploitation of technology and streamlined acquisition. IWS 5.0 works across a variety of systems and platforms including submarine combat systems, surface ASW combat systems (Cruisers, Destroyers, LCS and Frigates), surveillance sonar systems, CVN Tactical Operations Centers, and both afloat and ashore USW command and control (C2) systems.

Toward these ends, IWS 5.0 is leveraging cutting edge technologies and processes to save time and resources while delivering capabilities faster to the warfighter. The Integrated Mine & Undersea Warfare Information Desk (MUW InfoDesk), Integrated Product Data Management (iPDM) and Acquisition Management Tools (AMT) Environment are three examples of web-based solutions used to optimize online collaboration, workflow efficiencies, knowledge management, and organizational visibility and oversight, all of which are especially important in this time of maximum telework and workforce flexibility.

IWS 5.0 continues to lead the effort to vertically integrate the USW C2 system-of-systems (SoS) through Project NAUTICA (Networked Architecture for Undersea Theater Integrated C2 Advantage). Project NAUTICA spans over a dozen program offices, three resource sponsors, three TYCOMs, and variety of S&T efforts. Having utilized a SoS approach to identify and address theater USW C2 gaps, NAUTICA is employing model-based system engineering (MBSE) approach to support continuous, flexible, and rapid changes to fleet operational doctrine and requirements and their translation into capability requirements.

## UNDERSEA MINE WARFARE COMMITTEE



**JON TOBIAS, CHAIRMAN**

**KEVIN HAGAN, DEPUTY CHAIR**

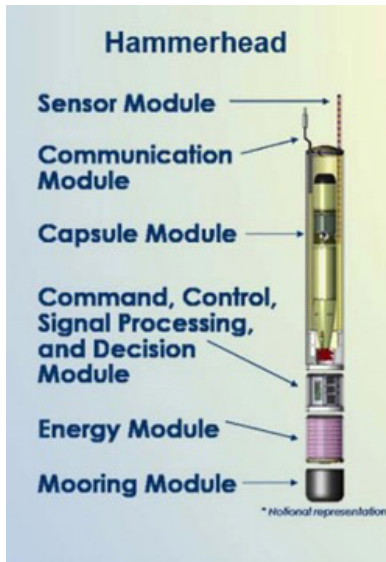
With the U.S. Navy's renewed focus on great-power competition, the Mine Warfare (MIW) mission area has seen an increase in focus from senior Navy

leadership. China, Russia, and Iran's mining capacity and capabilities pose formidable threats. Additionally, the U.S. fleet expects to encounter strong opposition in areas in which it needs to project power. The Pentagon recognizes that both problems require a robust MIW capability.

In mine countermeasures acquisition news, industry proposals are also due next month for production of the Mine Countermeasures (MCM) Unmanned Surface Vessel (USV). The craft is being developed separately from its payloads, the first of which are expected to be an influence minesweeping system and a minehunting sonar. However, the modularity of the design will allow for other payloads to be integrated as closure is sought for warfighting capability gaps.

Also, due next month are proposals for Naval Information Warfare Center Pacific's follow-on Unmanned Maritime Support Services IDIQ. The expected \$1.8B multiple-award contract will cover hardware and software for maritime mission areas including MCM, explosive ordnance disposal, anti-submarine warfare and intelligence, surveillance, and reconnaissance.

Mining continues to gain long-needed momentum and industry proposals are due next month for the Navy's Hammerhead



mine production program, which is being fast-tracked under the Navy's Maritime Accelerated Acquisition and an acquisition rapid prototyping program. Hammerhead revives the capability previously provided by the Mark 60 CAPTOR system, using a modified version of the Mark 54 Lightweight torpedo to primarily target adversary submarines. Hammerhead differs from CAPTOR in that it has a remote-control capability that ostensibly allows it to be placed in peacetime and is intended to be deployed clandestinely, likely by large displacement or extra-large unmanned underwater vehicles (XLUUV). Boeing has been contracted for fabrication of five XLUUVs over the next two years.

While the new mining capability is set to be delivered underwater, MCM missions will still launch from the surface. With the steady decrease in availability of legacy MCM platforms (USS Champion, USS Ardent, and USS Scout all decommissioned last year), Littoral Combat Ship (LCS) is being heavily relied upon to close capacity gaps. End-to-end testing of the LCS's MCM Mission Package (MP) was set to begin this fiscal year and is scheduled to reach initial operating capability in 2022. In addition to LCS, experimentation with Expeditionary Sea Bases as MCM MP host platforms continues.

As ever, the mine warfare community faces significant challenges as it strives to bring capability to the fleet and, as always, the MIW Committee challenges you to stay engaged and creative as we work together to improve the development and delivery of warfighting capabilities.

## UNDERSEA WARFARE VEHICLES COMMITTEE



**TOM RUZIC, CHAIRMAN**

**CHUCK FRALICK, DEPUTY CHAIR**

Despite the fact they've been under development for decades, Unmanned Underwater Vehicles, or UUVs, are still in their infancy for the U.S. Navy.

Unmanned vehicles are best known to us in the airborne realm. Many of these are not "unmanned" at all; rather, they are actually remotely piloted. Truly unmanned vehicles have no human in the loop. The vehicle is given a set of instructions, launched, and a human has no interaction with it until the mission is complete. The most common example of this at the retail level is the

Roomba vacuum cleaner. To be sure, self-driving cars are coming onto the scene, self-driving tractors aren't far behind, and there is even work being done on developing autonomous cargo ships.

In order for a UUV to have military utility, it must be stealthy, which rules out most forms of communications. Broaching a mast for radio communications and acoustic communications gives away the position of the vehicle, so the operational airborne model of "unmanned" vehicles in other environments will not work in the undersea domain.

There are three large technical barriers for the enterprising entrepreneur to address: autonomy, stored energy, and reliability.



## Autonomy

Navigating undersea is arguably the most difficult environment for any unmanned vehicle. Currents, variations in salinity and temperature, and avoiding obstacles and other vehicles are just some of the challenges. Advances in computing processing, miniaturization, software, and machine learning algorithms all contribute to ongoing improvements in this area. Fleets of airborne drones performing impressive light shows illustrate what is possible with software and netted sensors. One day, such advancements will enable undersea fleet operations in a swarm of pilotless vehicles to perform routine missions be they force protection, harbor surveillance, or offensive mining. Figure 1 shows the Knifefish UUV in an operational scenario.



*Figure 1. Knifefish*

Decision-making artificial intelligence to avoid a sea mount, fishing net, or mine-like object is fundamental. Navigation, way points, sea keeping, and target discrimination must be perfected. Just getting to a location is not enough. Completing a mission includes data gathering, launching a weapon, leaving a payload, or sending real time intelligence to an information node. Self-scuttling, cybersecurity, and tamper-proof design are also critically important.

Many advances have been made in the area of autonomy, largely due to vehicles and sensors developed for other environments. However, this still remains one of the most compelling challenges for unmanned undersea vehicles.

## Stored Energy

The energy demand for undersea vehicles is daunting. While SSNs have perfected the limitless power of nuclear energy, that's not an option for unmanned vehicles. Energy density for vehicles is easily the limiting factor for range and endurance. Battery technology, fuel cells, and even solar power has been the focus of intense development for more than a decade. Tremendous advances have been made, but much remains to be done. Not only is improving the power density of the source a challenge, those gains cannot be offset by auxiliary and control systems or thermal management.

Safety is an important issue as the limits are pushed in stored energy. While the vehicle is unmanned, it still must be handled and stored. Dense energy storage requires appropriate safeguards that must be thoroughly tested. Consumer products with battery safety

issues have been reduced but still remain a concern.

Ensuring the reliability of stored energy systems requires enormous amounts of testing to ensure they will continue to work when far away from human intervention. Flawless operation is rarely an attribute of a newly developed technology. Any power system is only as good as the control system that governs it. Ramping power up and down, response time, and management of any by products has to be adequately accounted for. The vehicle's autonomy system will inevitably be equipped with power control, and reliable sensors are needed.

Recharging of the energy system is another possible design requirement. The Navy has initiated development of underwater wireless power transfer for a vehicle proximate to a power station or a larger vehicle that holds out many possibilities.

## Reliability

One of the most overlooked but critically important requirements of any UUV is overall system reliability. The fact that there will be no human aboard to do anything for any system plays into many design considerations. For the long-endurance mission, no crewmember will be there to clean a filter, adjust a setting, or detect a hydraulic leak.

As such, systems and components must be able to operate the length of the deployment with no maintenance. The need to operate at times on the surface in varying sea states, and submerged at various pressures in a corrosive environment may play havoc with commercial off the shelf components that have been perfected in domains other than undersea.

Systems designed for robust performance with no maintenance or adjustment despite the potential for marine growth, temperature extremes, and corrosion present a unique set of challenges. Depending on the mission, many UUV applications may require the unit be recoverable, either for data exfiltration or reuse.

Designing a vehicle with anti-tamper attributes is another unique demand for military undersea vehicles. Critical vehicle systems and information storage must be protected from compromise if confiscated and subjected to adversary reverse engineering. Most important is the cybersecurity of any data or software contained in the C4I systems on board.

## So, what?

Many members of the NDIA Undersea Warfare Division are well aware of the challenges posed by unique environment and the military requirements of UUVs. Many of those same members are making strides to meet them. The important thing to remember is that, while there are many advancements being made in the undersea environment by the oil and gas and telecommunications industry, none of those are specifically unmanned, stealthy, nor possess military utility. The challenges highlighted here make the UUV problem particularly difficult to solve, which is why so many technically advanced companies and highly qualified individuals are working on it.

## UNDERSEA WARFARE AVIATION COMMITTEE



**GLEN SHARPE, CHAIRMAN**

**MR. BOB KANYUCK, DEPUTY CHAIR**

**CAPT DANIEL PAPP, USN, NAVY LIAISON, NAVAIR PMA 264**

Recent accomplishments for Navy Aviation undersea warfare are provided below and released in the public domain.

“Checking on Station” by **RADM Lance Scott CPRG**, [MPA Magazine 2021QTR1 \(adobe.com\)](#)

Maritime Patrol and Reconnaissance Warriors Past and Present, *“I do solemnly affirm that I will support and defend the Constitution of the United States of America against all enemies, foreign and domestic...”*



Familiar words, words that we live by. Recited many times over the course of a military career spent in service to our nation, the oath represents an unbreakable contract that pledges our last full measure of devotion to an ideal that is bigger than any one person, group, or political party. It is adherence to the oath, supported by our guiding core values of Honor, Courage, and Commitment, that drives the Maritime Patrol and Reconnaissance Force (MPRF) to maintain the highest standards and combat readiness to win in great-power competition. In light of the challenges brought by an ongoing pandemic, rest assured that your MPRF has never been in greater demand or better positioned to answer the call whenever and wherever needed.

In fact, the MPA community has achieved many transition milestones even in the face of a precipitous rise in the operational tempo of high-end competitors. Proficient PRC and RFN navies challenge ASW crews and systems with exploitation of the environment, advanced platform quieting technologies, and sophisticated countermeasures and tactics. Fielding advanced ASW sensors that can take away the few remaining environments conducive to submarine concealment and counter their countermeasures is paramount. Fortunately, your MPRF remains engaged in a successful decade-long transformation to a Family of Systems designed to be the ASW eyes, ears, and ball bat of the Navy, with a global and rapid response that brings real-time Maritime Domain Awareness (MDA) to Combatant and Fleet commanders.

The operational deployment of P-8A Poseidon, MQ-4C Triton, and TacMobile ground support have all but replaced USN's P-3C Orion. Four of 12 active component VP squadrons, with

seven P-8As each, are continuously deployed. Additionally, we are currently flying two VUP-19 Triton baseline jets from INDOPACOM—controlled from Mission Control Stations in Jacksonville—as an early operational capability. Our two reserve squadrons, the FRS, and VQ-1 continue to operate the P-3C or EP-3E Aires, and will do so for a few more years as we deliver more P-8As and Triton Multi-INT. Recognizing the critical contributions of the Maritime Patrol community to national defense congress has supported an increase in our P-8A inventory objective over the last two years. Adding two jets in the FY20 budget and nine in FY21, there are now enough jets projected in the inventory to recapitalize our reserve VP squadrons to P-8A.

Our allies and partners continue to recognize the value of a strong Navy and the contributions of Maritime Patrol aviation to their national interests. Many of them have procured, or are seeking to procure, the P-8A Poseidon and Triton. Moreover, all express a desire to operate closely with the USN MPRF, to include mutual support by TacMobile and leveraging logistics pipelines where it makes sense. The 50+ jets being purchased by our allies and partners are a real force multiplier and will be critical in meeting the resurgence of Russia and China in great-power competition. In a “back to the future” moment, the United Kingdom is coming on strong in the North Atlantic, and Norwegian and Kiwi aircrews are currently being trained at VP-30. Over the last few months, we have operated from the same Cold War bases that most of you are familiar with, including Bermuda and Keflavik. Access to allied basing and supply points is absolutely necessary to win the high-end fight. Exercising those relationships and processes now is the best way to ensure victory later.

I very much appreciate your continued support of Maritime Patrol Aviation and am excited at the opportunities ahead. While this spring's MPA symposium will be virtual, I remain optimistic that we will be able to come together in person later this year in Whidbey Island. Until then, stay healthy and know that the Maritime Patrol and Reconnaissance Force continues to Fly, Fight, Lead, and Win!

With great respect,

Lance Scott, Rear Admiral, U.S. Navy

Commander, Patrol and Reconnaissance Group/Patrol and Reconnaissance Group Pacific

# NAVY AWARDS CONTRACT FOR P-8A POSEIDON PROTECTION

1/20/2021

BY MANDY MAYFIELD



*BAE Systems Illustration*

The Navy recently awarded BAE systems a \$4 million contract for a “quick turnaround” demonstration of a new radio frequency countermeasures system for the P-8A Poseidon maritime patrol aircraft, the company announced in January.

“Its primary mission is twofold. First, it’s to prevent an enemy radar from locking” onto U.S. aircraft, said Don Davidson, director of the advanced compact electronic warfare solutions product line at BAE Systems. However, “if they do get a radar lock and fire a missile, its ultimate purpose is to seduce the missile away from the platform.”

The system will be pod-mounted and include a small form factor jammer, a high-powered amplifier and BAE’s AN/ALE-55 fiber-optic towed decoy.

The decoy has been used on board other Navy aircraft such as the F/A-18E/F Super Hornet.

“Right now on the P-8A, they don’t have any of the equipment required to support a self-protection system,” Davidson said in an interview.

“We had to put all that equipment within a pod that can be mounted on the aircraft without requiring anything on the aircraft itself.”

The company will design, build and integrate the systems at its Nashua, New Hampshire, facility. Following the integration, they will be tested for two months in early 2021 on the P-8A.

“This need for speed is even more prevalent today than it has been in years past,” Davidson said.

The Navy issued a white paper identifying concerns about emerging threats with regard to surface-to-air missiles and asked for a self-protection capability to be delivered quickly, he noted.

“Since we do this for a living, we had a lot of products and capabilities that we had developed for other applications that we were able to leverage,” he said. “We could take these existing capabilities, integrate them together — they’re small enough to fit in this pod — and we could bring this capability to bear in what has essentially been five months.”

The completed pod was slated to be delivered at the end of January 2022, he said.



# UNDERSEA WARFARE SENSORS COMMITTEE



**JOSEPH CUSCHIERI, ACTING CHAIRMAN**

**MR. PETER SCALA, NAVY LIAISON, PEO IWS 5.0**

The Spring Conference of the Undersea Warfare Committee of NDIA is coming up shortly this March 23 and 24, 2021. As in the Fall 2020, the conference will be virtual and the presentations will be limited to Distro A. There are three elements of

the Spring Conference. March 23 is Plenary Day with a full day of presentations covering different aspects of Undersea Warfare from Navy Leaders. March 24 is shaping nicely with presentations in each of the areas represented by the Technical Committees. The Undersea Sensors Committee has two presentations that are expected to have a wide audience appeal. The third element is the submitted presentations, which will be available on demand. As of the abstract deadline, there are currently 7 on-demand papers. In spite of Distro A publishing restrictions that are challenging and understandably frustrating for our authors, it is important to keep the momentum moving forward. We look forward to time when we return to an in-person conference venue. It's been one year since the last newsletter and quite a few things have happened. However, the Undersea Sensors contribution in this issue of the newsletter is being dedicated to the sensor challenges that are associated with the Large Displacement UUV (LDUUV).

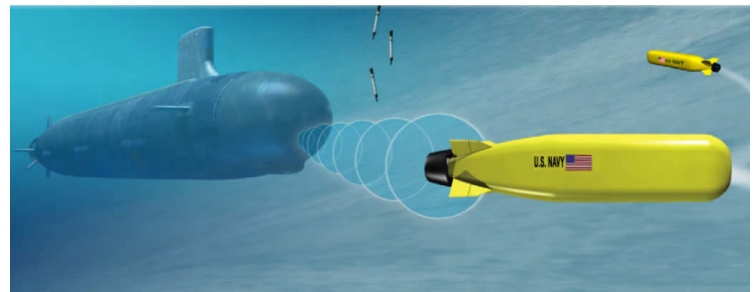


*Figure 1. A surrogate Large Displacement Unmanned Undersea Vehicle (LDUUV) in preparation for a test to demonstrate the capability of the Navy's Common Control System (CCS) at the Naval Undersea Warfare Center Keyport (U.S. Navy Photo)*

The U.S. Navy recently released an RFP for the design, development, and fabrication of the Naval Sea Systems Command (NAVSEA) Program Executive Office for Unmanned and Small Combatants' Large Displacement Unmanned

Undersea Vehicle (LDUUV/Snakehead) program (Figure 1). Snakehead is a long-endurance, multi-mission UUV, deployed from submarine large open interfaces, with the capability to deploy reconfigurable payloads. It is the largest UUV intended for hosting and deployment from submarines. The intent is to have full integration of Snakehead with the Modernized Dry Deck Shelter and Payload Handling System-equipped submarines. The initial mission designated for the LDUUV platform are support for the Intelligence Preparation of the Operating Environment (IPOE) missions.

LDUUV/Snakehead must deploy very power-efficient IPOE sensors to be able to achieve the long endurance mission utilizing only onboard energy or regenerative energy without surfacing. For IPOE, the sensor trade is to optimize sensor swath, sensor resolution, sensor power use, and sensor search area coverage and rate to meet the search area requirements for Snakehead. The challenge to the sensor community is optimizing the design of IPOE sensors through the combination of frequency of operation of the sensor and the SWaP of the sensor.



*Figure 2. Undersea Communications with LDUUV*

IPOE is one part of the sensor requirements, another part is the requirement for LDUUV to maintain communications with the host platform while submerged and achieve reliable communications over an acceptable long range. Acoustic modems can achieve long range communication by sacrificing bandwidth. As an Undersea Sensor community, sensors and systems for undersea communication are still part of the forefront of challenges.

LDUUV launch and recovery present another set of challenges in relation to the required Undersea Sensors for the fully autonomous docking of the LDUUV with either the modernized Dry Deck Shelter (DDS) or the Payload Handling System (PHS) for such equipped submarines. LDUUV and the host platform must rely on a number of undersea sensors to navigate the LDUUV towards the recovery area and safely capture Snakehead into the DDS or the host PHS.



# CONFERENCE CHAIR'S MESSAGE

**ANDY WILDE, CHAIRMAN, SPRING AND FALL CONFERENCE**

The Spring Conference's theme, "A Novel Force – Integrating Undersea, Subsea, and Seabed Capabilities in Distributed Maritime Operations," focuses on the capabilities that both present and future, manned and unmanned undersea warfare systems can bring to an integrated undersea battlespace to support the U.S. Navy's vision for sustaining undersea superiority now and into the future. This year's outstanding group of plenary speakers represents the full spectrum of undersea warfare and command, control, communications, computers, and intelligence expertise.

The conference focuses on new concepts that exploit capabilities that manned and unmanned platforms teamed together to enable a navy that swarms at sea. We will explore CONOPS to test, evaluate, and exploit these capabilities into an integrated, any-sensor/any-shooter kill chain to enable long-range fires above and below the sea. It will also explore development of the Navy operational architecture to support

this effort with speed beyond the legacy, incremental, and tribal approaches of the past.

The plenary session will feature presentations by Commander, Submarine Forces; Commander, Submarine Force Pacific; Director, Undersea Warfare Division, N97; Chief of Naval Research; Program Executive Officer, Submarines; Program Executive Officer, COLUMBIA; Program Executive Officer, Command, Control; Communications, Computers, and Intelligence; and Commander, Naval Undersea and Surface Warfare Centers.

Attendance provides you the opportunity to gain insight into the challenges and capability gaps that the Navy faces across the entire spectrum of the undersea domain. Take advantage of this opportunity to hear our defense and Navy leaders' views on the issues confronting the Navy industry-academia team as we navigate the waters of an uncertain future that will present new challenges to sustaining our undersea dominance.



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