NDIA

UPDATED 9.14.18

2018 JOINT UNDERSEA WARFARE TECHNOLOGY FALL CONFERENCE

MAINTAINING DOMINANCE IN THE UNDERSEA DOMAIN DURING SSN GAP YEARS

September 17-19, 2018

U.S. Naval Submarine Base

Groton, CT

NDIA.org/USWFall18

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NDIA

WHO WE ARE

The National Defense Industrial Association is the trusted leader in defense and national security associations. As a 501(c)(3) corporate and individual membership association, NDIA engages thoughtful and innovative leaders to exchange ideas, information, and capabilities that lead to the development of the best policies, practices, products, and technologies to ensure the safety and security of our nation. NDIA's membership embodies the full spectrum of corporate, government, academic, and individual stakeholders who form a vigorous, responsive, and collaborative community in support of defense and national security. For more information, visit **NDIA.org**

LEADERSHIP

Mike Tucker
Division Chair

Mark Kenny
Vice Chair

Mike Cortese
Deputy Chair

UNDERSEA WARFARE DIVISION

WHO WE ARE

NDIA's Undersea Warfare Division fosters the exchange between government and industry of technical information and expansion of research and development in areas related to undersea warfare. To this end, the division furthers communication by providing a variety of ways for government and industry to work together to solve problems, identify affordable solutions and meet specific requirements. The group also supports both government and industry with advice on undersea warfare policies and acquisition planning.

WELCOME

NDIA

I welcome all of our attendees to the National Defense Industrial Association's 2018 Joint Undersea Warfare Technology Fall Conference. The NDIA Undersea Warfare Division members are proud to bring you this annual conference.

This conference concentrates on the Navy's core competency mission of countering submarine and mine threats to the free and open flow of sea borne commerce and to the conduct of power projection from the sea. All Navy platforms and elements of the Navy force structure are involved in undersea warfare: submarines, surface combatants, fixed and rotary wing aircraft, surveillance units, and the Navy's command and control infrastructure. The USW Division has five active Technical Committees in which the Division focuses on the navy's mission areas: Sensor Systems, Mine Warfare Systems, Undersea Vehicles (including weapons), Aviation, and C4I and Combat Systems and Warfighter Performance. The technical sessions on the second day of the conference focus on recent events, advancements and challenges in each of these mission areas.

The mission of the NDIA's Undersea Warfare Division is to focus on critical undersea warfare areas related to the development, production, testing and logistic support of underwater combat systems. This includes mines, torpedoes, manned and unmanned underwater vehicles, countermeasures, sensors, weapon control and handling equipment; and the integration of systems aboard aircraft, ships and submarines.

The NDIA's Undersea Warfare Division fosters the exchange of technical information between government and industry and the expansion of research and development in areas related to undersea warfare. To this end, the division furthers communication by providing a variety of ways for government and industry to work together to solve problems, identify affordable solutions and meet specific requirements. The group also supports both government and industry with advice on undersea warfare policies and acquisition planning.

Your feedback is highly encouraged to ensure we continue to meet your needs.

Sincerely,

CAPT Robert Dunn, USN (Ret)
Chairman, Joint Undersea Warfare Technology Fall Conference
Government Relations Manager, General Dynamics Electric Boat

SCHEDULE AT A GLANCE

TUESDAY, SEPTEMBER 18

Registration
Dealey Center Auditorium
7:00 am - 5:00 pm

Continental Breakfast
Dealey Center Courtyard
7:00 - 8:00 am

Plenary Session
Dealey Center Auditorium
8:00 am- 5:00 pm

Networking Lunch
Base Gymnasium
11:55 am - 1:10 pm

Networking Reception
North Lake
6:00 - 7:00 pm

Networking Dinner
North Lake
7:00 - 9:30 pm

WEDNESDAY, SEPTEMBER 19

Registration
Dealey Center Auditorium
7:00 am - 5:00 pm

Continental Breakfast
Dealey Center Courtyard
7:00 - 8:00 am

Technical Sessions
Various Base Locations
8:00 am - 5:00 pm

Networking Lunch
Dealey Center Courtyard
12:00 - 1:00 pm

EVENT INFORMATION

LOCATION

U.S. Naval Submarine Base
New London - Groton, CT

ATTIRE

Industry: Business Casual
Civilian Speakers: Coat and Tie
Active Duty Military: Khakis
Military Speakers: Khakis

SURVEY AND PARTICIPANT LIST

You'll receive via email a survey and list of attendees (name and organization) after the conference. Please complete the survey, which helps make our event even more successful in the future.

EVENT CONTACT

Carol Dwyer
Meeting Planner
(703) 247-2582
cdwyer@ndia.org

Macon Field
Assistant Vice President, Divisions
(703) 247-9491
mfield@ndia.org

PLANNING COMMITTEE

Joe Cuschieri
Deputy Session Chair - Undersea Sensors

John Linderman
Session Chair - Warfighter Performance

Robert Dunn
Conference Chair

John Padgett
Conference Advisor

Chuck Fralick
Deputy Session Chair - Undersea Vehicles

Paul Rosbolt
Session Chair - C4I & Combat Systems

Kevin Hagan
Deputy Session Chair - Mine Warfare

Tom Ruzic
Session Chair - Undersea Vehicles

Eric Irwin
Conference Co-Chair

Glen Sharpe
Session Chair - Aviation USW

Mike Janik
Session Chair - Undersea Sensors

Jon Tobias
Session Chair - Mine Warfare

Bob Kanyuck
Deputy Session Chair- Aviation USW

Bob Zarnich
Deputy Session Chair - C4I & Combat Systems

SPEAKER GIFTS

In lieu of speaker gifts, a donation is being made to the Fisher House Foundation.

HARASSMENT STATEMENT

NDIA is committed to providing a professional environment free from physical, psychological and verbal harassment. NDIA will not tolerate harassment of any kind, including but not limited to harassment based on ethnicity, religion, disability, physical appearance, gender, or sexual orientation. This policy applies to all participants and attendees at NDIA conferences, meetings and events. Harassment includes offensive gestures and verbal comments, deliberate intimidation, stalking, following, inappropriate photography and recording, sustained disruption of talks or other events, inappropriate physical contact, and unwelcome attention. Participants requested to cease harassing behavior are expected to comply immediately, and failure will serve as grounds for revoking access to the NDIA event.

TRACK INFORMATION

Aviation USW

Glen Sharpe
Lockheed Martin Corporation

The Aviation session focuses on the capability, integration and synergies that the airborne Undersea community brings to the fight. Because of the wide range of "aviation platforms," from wide-body fixed wing to rotary winged, as well as the gambit of unmanned systems, the committee is interested in articulating the contributions and potential of these weapons systems. Desired technical subjects cover the broad areas of signal processing, human factors, training, undersea capable weapons, sensors, man-machine interface, littoral and large area search as well as the networking required to make all of this happen. The presentations cover a range, including theoretical discussions by academic institutions and laboratories, reports on experimental systems and systems being developed for Fleet introduction, and discussions of Navy programs of record.

C4I & Combat Systems

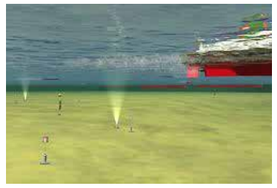
Paul Rosbolt
Systems Planning and Analysis, Inc.

The C4I & Combat Systems Technical session focuses on Communications, Information Exchange, Data Fusion and Command and Control enablers for the ASW Kill Chain F2T2EA (Find, Fix, Track, Target, Engage and Assess). Committee presentations are given by academia, government and industry and cover a broad range of topics from theoretical discussions to updates on technology, programs of record and test results. A special focus for this year's conference will be Information Assurance/ Cyber-Security as it relates to Undersea Warfare.

Mine Warfare

Jon Tobias
ITA International

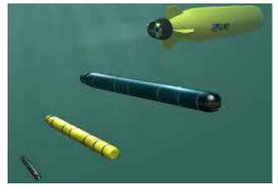
The Mine Warfare (MIW) session provides the opportunity for Industry, Government, and Academia to exchange information and express their views in addressing technical, programmatic and operational issues and activities in the MIW community. The Committee addresses threats, programs, operations, CONOPS, and future technologies across the MIW spectrum of mine hunting, mine sweeping, neutralization, command and control, mining and other areas of interest.



Undersea Sensors

Michael Janik
Raytheon Integrated Defense Systems

The focus of the Undersea Sensors session is to provide guidance to the U.S. Navy about the application of cutting edge technology. Abstracts submitted to this section should relate to the following: underwater acoustic transduction and acoustic sensor arrays, electro-optic sensors, magnetic sensors, electrostatic sensors, chemical sensors, gravity sensors, signal processing, test and evaluation, operational use/sea test results, and theoretical studies. This list is not exhaustive but representative of the disciplines and associated sciences.



Undersea Vehicles

Tom Ruzic
Huntington Ingalls Industries

The Undersea Vehicles session focuses on both large and small hull undersea vehicles (both manned and unmanned) and unmanned surface vehicles. Technical subjects cover the broad areas of weapons, unmanned vehicles, defensive systems and hull, mechanical and electrical systems. The technical committee presentations range from theoretical discussions by academic institutions and laboratories, reports on experimental systems and systems being developed for Fleet introduction, to discussions of Navy programs of record.

Warfighter Performance

Mr. John Linderman
The John Hopkins University-Applied Physics Lab

This special session on Warfighter Performance is intended to address evolving operational needs and solutions in the area of USW Warfighter Performance which employ a combination of components such as technology, HSI, Serious Games, Virtual Worlds, and other emerging concepts. Presentations in this session will address approaches that effectively combine cross discipline techniques and methodologies to provide real capability to the Warfighter across all USW Warfare Domains/Enterprises (i.e., Submarine, Surface, Air, and MIW Enterprises).

Human Systems Integration (HSI) - Improving data visualization techniques and enhancing intuitive decision making; improving the reliability of critical information Operator Capability

Training - Establishing linkages between theory, experiments, and training system design; integrating M&S to increase realism as well as cost efficiency of onboard submarine training capability

Health and Wellness - Reducing or countering the negative effects of fatigue, stress, illness, etc.; improving on-board environment with respect to atmosphere, nutrition, exercise, noise exposure, etc.

AGENDA

TUESDAY, SEPTEMBER 18

7:00 am - 5:00 pm — **REGISTRATION**
DEALEY CENTER AUDITORIUM

7:00 - 8:00 am — **BREAKFAST**
OUTSIDE PLAZA

8:00 – 8:15 am — **CALL TO ORDER AND WELCOME**
Mike Tucker
NDIA Undersea Warfare Division Chair

OPENING REMARKS
RDML Butch Dollaga, USN
Commander, Undersea Warfighting Development Center

INTRODUCTION OF SPEAKERS
Robert Dunn
NDIA Undersea Warfare Division Fall Conference Chair

8:15 - 8:45 am — ADM John Richardson, USN
Chief of Naval Operations

8:45 - 9:15 am — ADM Frank Caldwell, USN
Director, Naval Nuclear Propulsion Program

9:15 - 9:45 am — VADM Charles “Chas” Richard, USN
Commander, Submarine Forces; Commander, Submarine Force Atlantic; Commander, Allied Submarine Command

9:45 - 10:10 am — **NETWORKING BREAK**
OUTSIDE PLAZA

10:10 - 10:40 am — VADM David Johnson, USN
Principal Military Deputy, Assistant Secretary of the Navy for Research, Development and Acquisition

10:40 - 11:10 am — VADM William Merz, USN
Deputy Chief of Naval Operations for Warfare Systems (OPNAV N9)

11:10 - 11:40 am — RADM Daryl Caudle, USN
Commander, Submarine Force, U.S. Pacific Fleet

11:40 am - 11:55 pm — **AWARDS CEREMONY**
Pierre Corriveau
Undersea Warfare Division Awards Chair

11:55 am - 1:10 pm — **LUNCH**
BASE GYMNASIUM

1:10 pm — **INTRODUCTION OF SPEAKERS**
Robert Dunn
NDIA Undersea Warfare Division Fall Conference Chair

1:10 - 1:40 am — RADM David Hahn, USN
Chief of Naval Research; Director of Innovation, Technology Requirements and Test and Evaluation (OPNAV N94)

1:40 - 2:10 pm — RDML David Goggins, USN
Program Executive Officer for Submarines

2:10 - 2:40 pm — CAPT Douglas Belvin, USN
Program Executive Officer for Air ASW / PMA 264

CAPT Christopher Ramdsen, USN
Chief of Staff, Patrol and Reconnaissance Group/Pacific

2:40 - 3:00 pm — **NETWORKING BREAK**
OUTSIDE COURTYARD

3:00 - 3:30 pm — RDML Moises DelToro, USN
Commander, Naval Undersea Warfare Center

3:30 - 4:00 pm — CAPT Peter Small, USN
PMS-406 Unmanned Maritime Systems

4:00 - 4:30 pm — Andrew Richardson
Deputy Commander, Office of Naval Intelligence

4:30 - 5:00 pm — RADM John Tammen, USN
Director, Undersea Warfare Division, Office of the Chief of Naval Operations, N97

5:00 pm — **CLOSING REMARKS**
Mike Tucker
NDIA Undersea Warfare Division Chair

5:05 pm — **ADJOURN**

6:00 - 7:00 pm — **NETWORKING RECEPTION (PRE-REGISTRATION REQUIRED)**
NORTH LAKE

7:00 - 9:30 pm — **NETWORKING DINNER (PRE-REGISTRATION REQUIRED)**
NORTH LAKE

The NDIA has a policy of strict compliance with federal and state antitrust laws. The antitrust laws prohibit competitors from engaging in actions that could result in an unreasonable restraint of trade. Consequently, NDIA members must avoid discussing certain topics when they are together at formal association membership, board, committee, and other meetings and in informal contacts with other industry members: prices, fees, rates, profit margins, or other terms or conditions of sale (including allowances, credit terms, and warranties); allocation of markets or customers or division of territories; or refusals to deal with or boycotts of suppliers, customers or other third parties, or topics that may lead participants not to deal with a particular supplier, customer or third party.

TECHNICAL SESSIONS

WEDNESDAY, SEPTEMBER 19

	C4I Paul Rosbolt, Session Chair Lewis Hall	Combat Systems / Warfighter Performance Paul Rosbolt, Session Chair John Linderman, Session Chair Building 83, Room 318	Mine Warfare Jon Tobias, Session Chair Building 83, Room 319	Aviation USW Glen Sharpe, Session Chair Building 83, Room 327	Undersea Sensors Mike Janik, Session Chair Joe Cuschieri, Session Co-Chair Dealey Center Auditorium	Undersea Sensors Building 83, Room 317	Undersea Vehicles Tom Ruzic, Session Chair Chuck Fralick, Session Co-Chair Bledsoe Hall	Undersea Vehicles Dealey Classroom
8:00 am	21623 Assuring Undersea Dominance Through the Undersea Communications & Integration Program Office **CAPT Michael Boone, USN** PEO C4I / PMW 770	21700 PMS 425 Program Overview **CAPT Gregory Zettler, USN** NAVSEA PMS 425	21460 Active Sonar Matched Waveform for Resonant Spherical Mine Target **LT Justin McCorkle, USN** NPS	21470 Air ASW Systems (PMA-264) **CAPT Douglas Belvin, USN & CDR Matt Farr, USN** PMA-264, NAVAIR	21477 IWS5 Advanced Development Status **Peter Scala** PEO IWS 5		21479 Defining VIRGINIA Class Block VI Within the Context of the Tactical Submarine Evolution Plan **David Nagy** OPNAV N97	21718 UUV Core Technologies **Robert Iera** NAVSEA - PMS 406
8:30 am	21478 Advanced Naval Technology Exercise 2018 Demonstration Overview Cross Domain C3 for Manned/Unmanned Systems Intelligent Collaboration **Larry Schluderberg** General Dynamics Mission Systems	Tactical Control AxB **Steve Potochniak** PEO IWS5	21616 NSWC PCD Investments in MIW **Dr. Peter Adair** NSWC PCD				21638 Merits of Advanced Materials for Future Submarine Propulsor Development **Dr. John Vlattas, Patrick Taylor & Josalyne Ma** NAVSEA 073	21524 Employing Untethered Transformational Capabilities In Denied Subsea Environments **Michael Fry** QinetiQ North America
9:00 am	21618 Findings from a Navy-Industry Workshop on Seabed Warfare **John Lademan** Northrop Grumman	21701 Rapid Acquisition via the DIUx **Jacob Glassman** NAVSEA PMS 425	21642 Affordable Man-Portable SAS Solution for MIW **Dan Lawrence** Riptide Autonomous Solutions	21445 DICASS Noise Analysis **Ronald Buratti** RDA, Inc.	21303 PMS 485's Deployable and Mobile Surveillance Systems Update **Susan LaShomb, Joseph Grant & Mandeep Nehra** PMS 485	21325 Deployment of Novel Underwater Sensors using UAVs **Dr. Mark Paulus** NUWC Division, Keyport	21646 688 Quick Look Study – Achievable Capability Insertions for Life-Extended LOS ANGELES-Class Ships in the SSN Gap Years **Kevin Bowe** Newport News Shipbuilding	21840 Unmanned Undersea Vehicle Requirements Group (URG) Capability Needs and Priorities **LCDR Blake Klinedinst, USN** OPNAV N97
9:30 am	21696 Testing Your Comms System at the Navy's Undersea Data and Power Test Bed **Joshua Henson** PEO SUB, PMS 485	Sub-Launched Harpoon **Ed Rishmany** NUWC	21709 Mine Countermeasures – A Fleet Perspective **CAPT Ron Toland, USN** SMWDC	21575 DDVLA Sonobuoy Program Update **Daryl Hawkins & William King** SeaLandAire Technologies, Inc	21713 Seabed Surveillance System Signal Processing and Automation Modernization **Eric Hatcher** ARL UT-Austin	21612 Compact Littoral ASW SONAR for Very Small to Medium USV **Tom Reynolds** Kongsberg Maritime U.S.	ONI Acoustics Intelligence Update **ONI TAC-65**	21482 Subsea and Seabed Warfare Initial Capabilities Document **LT David Rezzo, USN** OPNAV N97
10 am	**BREAK**				**BREAK**			
10:30 am	21485 Payload Delivery Systems for Advanced Tactical Applications **Dr. David Powell** Sparton	21533 Undersea Systems Program Office Update **CAPT Doug Adams, USN** PEO IWS 5.0	21473 "Smart" Unmanned Maritime System of Systems for Counter UUV/MIW Operations **Dan Redman** Northrop Grumman	21631 Underwater Target Detection in Hyperspectral Remote Sensing Imagery **Dr. David Gillis** NRL	21726 Affordable Mobile ASW Surveillance System **Tracey Fischer** TAF & Associates	21626 Employing Distributed Acoustic Sensing for Infrastucture Protection **Michael Fry** QinetiQ North America	21647 Technology Development for Lithium ion Battery Platform Certification **Dr. Joseph Fontaine** NUWC	21695 Testing Your UUV at the Navy's Undersea Data and Power Test Bed **Joshua Henson** PEO SUB, PMS 485

	C4I Paul Rosbolt, Session Chair	Combat Systems / Warfighter Performance Paul Rosbolt, Session Chair John Linderman, Session Chair	Mine Warfare Jon Tobias, Session Chair	Aviation USW Glen Sharpe, Session Chair	Undersea Sensors Mike Janik, Session Chair Joe Cuschieri, Session Co-Chair		Undersea Vehicles Tom Ruzic, Session Chair Chuck Fralick, Session Co-Chair	
	Lewis Hall	Building 83, Room 318	Building 83, Room 319	Building 83, Room 327	Dealey Center Auditorium	Building 83, Room 317	Bledsoe Hall	Dealey Classroom
11:00 am	21471 Communications Architectures for C4I in Hostile EM environments **Dr. Donald Steinbrecher** AVSEA	21587 Demonstrating 3rd Party Targeting **Chris Laliberte** NUWC	21611 Sonobuoy Launcher Compatible UUV **Tom Reynolds** Hydroid, Inc.	ONI Potential Adversary USW Forces Ops and Tactics **ONI TAC-12**	21502 Improved Signal Processing for Pulsed Narrowband Waveforms **Travis Cuprak** L3 Adaptive Methods	21594 Interoperable Sidescan Sonar Evaluation **Gregory Folts** QinetiQ North America	21619 Implementation of Real-Time Internal Short Circuit Detection for Enhanced Safety and Reliability of Li-Ion Batteries for UUVs **Dr. Brian Barnett** CAMX Power	21637 Protecting Naval Assets in Port with Autonomous Swarming AUVs **Brendan McNelly** JHU-APL
11:30 am	21610 Demonstration of a Vehicle-to-Vehicle Optical Pointing, Acquisition, and Tracking System for Undersea Laser Communications **Dr. Nicholas Hardy** MIT Lincoln Laboratory	21493 PMS 415 Update **Robert Gerstein** PEO Submarines, PMS 415	21475 Concepts for MOEs, Risk, and Values of Minefields **Dr. Joshua Edwards** NSWC PCD	ONI Threats to the USN Industrial Base **ONI TAC-13**	21694 Testing Your Sensor at the Navy's Undersea Data and Power Test Bed **Joshua Henson** PEO SUB, PMS 485	21544 Underway Ship Hull Inspections using High-Resolution Imaging Sonars **John Pietrzyk, Paul Ryu & Dr. Nicholas Pulstone** MIT Lincoln Laboratory	21588 Air Independent, PEMFC Power System for Marine Applications **Robert Utz & Robert Sievers** Teledyne Energy Systems, Inc.	21481 Design and Analysis of Swarming Architecture for Unmanned Systems in Air, Sea, and Space Environments Using Goal Oriented Requirements Engineering **Andre Douglas** JHU-APL
12 pm	**LUNCH**				**LUNCH**			
1:00 pm	21583 Unhackable: A Strategic Framework for Cyber Resilience **John Zimmerman** Subsystems Technologies, Inc.	21621 Common Electronic Toolset for Submarine Qualification and Training. **George Adilinis** NUWC	21511 High-Temperature Superconducting MCM for USVs **Peter Ferrera** NSWC	ONI Acoustic Communications in USW Domain **ONI EDT-2**	21607 Multi-Sensor Tracker **Matthew Exley & Dr. Steven Bordonaro** NUWC	21444 Design and Modeling of a Compact Correlation Velocity Log for Small UUVs **Thomas Blanford** ARL-Penn State	21615 Integration and Application of Lasers on Submarines **Dr. Jerome Gormley** General Atomics Electromagnetic Systems	21486 DARPA Project: Positioning System From Deep Ocean Nodes **John Waterston, Aaron Kofford & Yevgeniy Dorfman** DARPA
1:30 pm	21600 Machine Learning and Artificial Intelligence in a Network Segmented Architecture **John Sprague & Dave Otero** World Wide Technology	21518 A First Look at VRSUB and the Future of Virtual Reality Training **Tyler Crafford & Timothy Moskalski** NUWC	21513 Multi-Spectral Imaging (MSI) Sensors for Undersea Warfare Missions **Richard Sterchele & Justin Randall** UTC Aerospace Systems		ONI Russian Sonar Systems **ONI TAC-51**	21599 The Effects of DVL Mounting Location on AUV Ego-motion and Pose Estimates **Christopher Monaco** ARL- Penn State	21499 Advanced Naval Technology Exercise (ANTX) Human Machine Interaction 2018 **Dr. Peter Hardro & Nicholas Delgreco** NUWC	21632 Feasibility of Fuel Cell Centric Power Modules for LDUUV and Other Submersibles **Dr. Daniel Wise** Siemens Government Technologies
2:00 pm	21630 How Digital Twin and Network Orchestration Keep Training and Technology Moving Forward in Gap Years **Kelly Jones** Cisco Systems	21597 SSBN Submarine Warfare Federated Tactical Systems (SWFTS) Modernization **Matthew Corser** NUWC	ONI-6 Foreign Mine Warfare Developments **ONI TAC-33**		21569 Early History of U.S. Navy Sonar **Timothy Straw** Rite-Solutions, Inc.	21625 Arctic Diffusive Staircases: An Overlooked Opportunity for Detection? **John Joseph** NPS	21483 Tailored Network Architectures for Sonar Image Classification **Dr. John McKay** Penn State	21629 Development of a Navy Safety-Certifiable Critical Battery Management System **Robert McCaig & Dr. Nanda Ramanujam** ASSETT, Inc.

WEDNESDAY, SEPTEMBER 19

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2:30 pm	21500 Utilizing Machine Learning and Data Mining to Improve the Detection Time of Obsolete Parts **Dr. Jennifer Williams, Dennis Summers & Jordan Love** NUWC, Division Keyport	21496 User Centered Design in the Acquisition Lifecycle **Lauren Ogren** NUWC	21641 Recent Advances in Synthetic Aperture Sonar Signal Processing **Dr. Daniel Brown** ARL-Penn State		21467 2018 – The Centennial of our Dominance in the Undersea Domain – How It All Began in New London, Connecticut, During "The Great War." **Roy Manstan**	21476 Underwater Electromagnetic Alternating Signature Model **Dr. Meagan Schaal & Dr. Srikanth Raghavan** NSWC	21640 Hybrid Reynolds-averaged Navier Stokes/Large-eddy Simulation of Buoyant Jets in Stratified Liquids **Chris Martin** VA Tech	21617 Progress on Affordable UUV Swarms **Joel Parry** Draper
3 pm	**BREAK**				**BREAK**			
3:30 pm	RF Machine Learning Signal Classification Performance **Bob Smarrelli** Expedition Technology, Inc.	21577 A Design for Human-Machine Teaming in Undersea Warfare **LCDR Ryan Hilger, USN & Jenny Roberts** OPNAV N97			ONI Chinese Sonar Systems **ONI TAC-51**	21582 NextGen Underwater Electromagnetic Signature Reduction Systems **Dr. John Holmes** NSWC, Carderock Division	21514 Progress Towards Multidisciplinary Design Optimization for Contemporary Stealth **Matthew Jones** VA Tech	21705 A Seabed Warfare in Denied Waters Demonstration at ANTX 2018 **Ross Lindman, Ben Conaway & Steve Somlyody** Huntington Ingalls Technical Solutions
4:00 pm	ONI Artificial Intelligence in USW Domain **ONI EDT-4**	21590 Capability to All Boats, All the Time: Beyond the TI/APB Model **Nicholas Guertin** Carnegie Mellon			21719 New Textured Piezoceramic Materials **Wayne Lee** Harris Corporation	21606 Rapid Reconstruction and Analysis of At-Sea Data **Christina Ushkevich & Adam Arrighi** NUWC	21624 Physics of Surface Piercing Bodies **Dane Hendrix** NSWC, Carderock Division	21639 Unmanned Undersea Vehicles and COTS use **Christopher Strong & Nick Gaetanos** Moog
4:30 pm	ONI Emerging Technologies: Swarm **ONI EDT-1**	21491 Rapid Prototyping for Submarine Payload Integration **Kevin Moore** NUWC			21490 Creating a Shallow Water Anti-Submarine Warfare Training capability with the Installation of the Undersea Warfare Training Range (USWTR) off Jacksonville, FL **LCDR Gregory Garnett, USN** NAVAIR	21501 Novel Thermal Acoustic Transducer Source in an A-sized Unmanned Undersea Vehicle (UUV) **Christian Schumacher** NUWC	ONI Potential Adversary Submarine ASUW Tactics **ONI OIC-210**	21633 Design, Development and Integration of a Payload Delivery Section Enabling Long-Transit and Multiple Payload Delivery at Precise, Pre-defined Locations by a UUV **Gordon Clark** General Dynamics Mission Systems
5 pm	**CONFERENCE ADJOURNS**				**CONFERENCE ADJOURNS**			

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BIOGRAPHIES

CAPT DOUGLAS BELVIN, USN

Program Executive Officer for Air ASW / PMA

Captain Doug Belvin attended Duke University via the Naval Reserve Officer Training Corps, graduating in 1993 with a degree in Electrical Engineering. Belvin also earned a post-graduate degree in Technical Management from Johns Hopkins and is a graduate of the U.S. Naval Test Pilot School, class 119.

Following his commissioning and flight training he qualified in the P-3C at NAS Jacksonville FL, and flew operationally with the Skinny Dragons of Patrol Squadron FOUR at NAS Barbers Point, HI. He qualified as a P-3C Patrol Plane Commander, Functional Check Flight Pilot, Instructor Pilot, and Mission Commander.

Belvin's subsequent flying assignments included tours as an operational and developmental test pilot. During his developmental test tour, he redesignated as an Aerospace Engineering Duty Officer (AEDO).

As an AEDO, Belvin served in a variety of program management assignments in four program office tours, and completed a tour on the staff for the Program Executive Officer for Air ASW, Assault, and Special Mission programs, PEO(A). He assumed command as the major program manager for Air ASW Systems, PMA-264, in August 2016.

CAPT Belvin holds Level III Acquisition Certification in Program Management, Systems Planning, Research, Development and Engineering, and Test and Evaluation. He has been selected into the Defense Acquisition Corps and NAVAIR Leadership Development Program. Awards include Meritorious Service Medal, Navy Commendation Medal, Navy Achievement Medal, and various campaign and unit awards.

ADM JAMES F. CALDWELL, JR., USN

Director, Naval Nuclear Propulsion Program

Admiral James Caldwell received his commission graduating with distinction from the United States Naval Academy in 1981 with a Bachelor of Science in Marine Engineering. He also holds a Master of Science in Operations Research from the Naval Postgraduate School.

Caldwell commanded USS Jacksonville (SSN 699) homeported in Norfolk, Virginia; Submarine Development Squadron (DEVRON) 12 in New London, Connecticut; Submarine Group 9 in Bangor, Washington; and the Submarine Force, U.S. Pacific Fleet, Hawaii. His sea tours include service in both the Atlantic and Pacific Fleets. His Operational assignments include duty as a division officer on USS Boston (SSN 703), engineering officer on USS Alabama (SSBN 731) (GOLD), and executive officer on USS Buffalo (SSN 715).

Ashore, Caldwell served on the Pacific Fleet Nuclear Propulsion Examining Board and later as Undersea Warfare (USW) Requirements officer on the staff of Commander in Chief, U.S. Pacific Fleet. He also served as senior member of the Naval Submarine Force's Tactical Readiness Evaluation Team; on the Joint Staff as deputy director for Politico-Military Affairs for Europe, the North Atlantic Treaty Organization, Russia and Africa; and deputy commander for U.S. Strategic Command's Joint Functional Component Command for Global Strike in Omaha, Nebraska and as Naval Inspector General, Washington Navy Yard, D. C. His most recent tour was on the (Office of Naval Operations) OPNAV Staff as the Director, Navy Staff.

He assumed his duties as the Director, Naval Nuclear Propulsion Program in August 2015.

Caldwell's awards include the Distinguished Service Medal, Defense Superior Service Medal, Legion of Merit, Meritorious Service Medal, Navy Commendation Medal, Navy and Marine Corps Achievement Medal, and the Naval Submarine League's Charles A. Lockwood Award for Submarine Professional Excellence.

RADM DARYL CAUDLE, USN

Commander, Submarine Force, U.S. Pacific Fleet

Rear Adm. Daryl Caudle is a native of Winston-Salem, North Carolina, and graduated from North Carolina State University (magna cum laude) in 1985, where he majored in chemical engineering. He was commissioned after attending Officer Candidate School in Newport, Rhode Island. Caudle holds advanced degrees from the Naval Postgraduate School, Master of Science (distinction) in Physics from Old Dominion University, masters in engineering management and from the School of Advanced Studies, University of Phoenix, where he obtained his Doctor of Management in Organizational Leadership with a specialization in Information Systems and Technology.

His doctoral dissertation research was conducted on military decision making uncertainty regarding the use of force in cyberspace. He is also a licensed professional engineer.

His early sea tours included assignments as division officer, USS George Washington Carver (SSBN 656G); engineer, USS Stonewall Jackson (SSN 634B); engineer, USS Sand Lance (SSN 660); and executive officer, USS Montpelier (SSN 765).

Caudle's first command assignment was as commanding officer of USS Jefferson City (SSN 759). As the deputy commander, Submarine Squadron 11, he served as commanding officer of USS Topeka (SSN 754) and USS Helena (SSN 725) due to emergent losses of the normally assigned commanding officers. He also commanded Submarine Squadron 3.

Tours ashore include assignments as assistant force nuclear power officer, Commander Submarine Force, U.S. Atlantic Fleet; officer-in-charge of Moored Training Ship (MTS635); deputy commander, Submarine Squadron 11; assistant deputy director for information and cyberspace policy on the Joint Staff (J5, strategic plans and policy) in Washington, D.C.; and chief of staff Commander Submarine Force, U.S. Pacific Fleet.

His other flag assignments include deputy chief for security cooperation, Office of the Defense Representative, Pakistan and deputy commander, Joint Functional Component Command-Global Strike.

Caudle is currently serving as commander, Submarine Force, U.S. Pacific Fleet. He is the principal advisor to the Commander, U.S. Pacific Fleet for submarine matters. Prior to this assignment, he was deputy commander, U.S. 6th Fleet; director of operations U.S. Naval Forces Europe-Africa; and commander, Submarine Group 8.

His personal decorations include the Defense Superior Service Medal (three awards), Legion of Merit (three Awards), Meritorious Service Medal (three Awards), Navy and Marine Corps Commendation Medal (five Awards), and the Navy and Marine Corps Achievement Medal (four Awards).

RDML CARL CHEBI, USN

Program Executive Officer, C4I / Program Executive Officer, Space Systems

Rear Adm. Carl Chebi, a native of Holliston, Massachusetts, earned a Bachelor of Science in Computer Systems Engineering and a commission as an ensign from the Naval Reserve Officer Training Corps at Rensselaer Polytechnic Institute. He is a graduate of the U.S. Naval Test Pilot School, Navy Fighter Weapons School and holds an Executive Master in Business Administration from the Naval Postgraduate School.

Chebi served operationally as an F-14 pilot in Fighter Squadron (VF) 142 deployed with USS Eisenhower (CVN 69), F/A-18 department head, executive officer and commanding officer of Strike Fighter Squadron (VFA) 192 deployed with USS Kitty Hawk (CV 63) to Atsugi, Japan. During these tours he participated in Operation Southern Watch and numerous Western Pacific deployments.

His shore tours include service as an aircraft and weapons test pilot in both Air Test and Evaluation Squadron (VX) 23 and 30. He also served as the deputy for Strike Aircraft Plans and Requirements for the Office of the Chief of Naval Operations.

Chebi has served in numerous acquisition tours beginning with the U.S. Naval Test Pilot School where he was selected to fly the Mirage 2000 aircraft in France. His program management experience includes serving as a deputy program manager for the F/A-18 and EA-18G Program (PMA-265), Precision Strike Weapons Program manager (PMA-201) and Naval Integrated Fires Program manager (PMA-298). Most recently, he served as vice commander of Naval Air Systems Command headquartered in Patuxent River, Maryland.

In February 2017, he assumed duty as program executive officer, command, control, communications, computers and intelligence (PEO C4I)/program executive officer, space systems (PEO space systems).

Chebi has over 3700 flight hours, 700 carrier arrested landings and has logged hours in the F/A-18 A-F, Mirage 2000, F-14A-D, F-15, F-16, P-51 and numerous other aircraft. He is the recipient of the Legion of Merit, Meritorious Service Medal and various unit and sea service awards.

RDML MOISES DELTORO, USN

Commander, Naval Undersea Warfare Center

Rear Adm. Moises DelToro III, grew up in South Bend, Indiana, and enlisted in the Navy in 1980. He was commissioned via the University of Utah Navy ROTC program in 1987 with a Bachelor of Science in Mechanical Engineering. He holds a Master of Science in Engineering Management from the Catholic University and a Master of Science in Resourcing National Security Strategy from the Industrial College of the Armed Forces.

His sea tours include command of the USS Rhode Island (SSBN 740 Blue) from March 2005 to March 2008. During this period, the ship was awarded two Battle Efficiency Awards for operational excellence and three Commander-in-Chief, Atlantic Fleet Retention Excellence Awards. DelToro also served as a division officer aboard USS Pittsburgh (SSN 720); engineer officer aboard USS Maine (SSBN 741 Blue), and executive officer aboard USS Salt Lake City (SSN 716), deploying to the Mediterranean, North Atlantic and Western Pacific, as well as conducting several strategic deterrent patrols.

Ashore he served as Nuclear Propulsion Officer Candidate Program Manager at Navy Recruiting Command, Action Officer on the Joint Staff (J-8), and Non-nuclear Enlisted Community Manager at the Bureau of Personnel.

DelToro also served as executive assistant to the Director, Submarine Warfare (N-97) for one year before entering the Acquisition Professional Community in 2009, where he served in a number of assistant program manager positions. DelToro served as the program manager for Undersea Defensive Warfare Systems from December 2011 to April 2015. During this period the program was awarded a Secretary of the Navy Excellence in Acquisition Award and a Coalition for Government Procurement Excellence in Partnership Award. He was the recipient of the 2013 Naval Submarine League's Vice Admiral J. Guy Reynolds Award for Excellence in Submarine Acquisition.

DelToro assumed command of the Naval Undersea Warfare Center (NUWC) in July 2015. In this position, he is responsible for leading more than 5,000 scientists, engineers, technicians and support personnel, both civilian and active duty, within two NUWC divisions. NUWC provides full spectrum research, development, test and evaluation, engineering, and fleet support for submarines, autonomous underwater systems, and offensive and defensive weapon systems associated with undersea warfare.

Personal awards include the Legion of Merit (two awards), Defense Meritorious Service Medal, Meritorious Service Medal (two awards), and various other personal, campaign, and unit awards.

RDML LEONARD C. "BUTCH" DOLLAGA

Commander, Undersea Warfighting Development Center

Rear Adm. Butch Dollaga is a native of Vallejo, California, and graduated from the United States Naval Academy in 1990 with a Bachelor of Science Degree in Mechanical Engineering. He holds a Master's Degree in Engineering Management from The George Washington University in Washington, DC.

His sea tours include, division officer assignments on USS Los Angeles (SSN 688), engineer officer onboard USS Rhode Island (SSBN 740)(B), and executive officer on USS Cheyenne (SSN 773). He commanded USS Charlotte (SSN 766) in Pearl Harbor, Hawaii and was Commodore of Submarine Development Squadron 12 in Groton, Connecticut.

His staff assignments include Admissions Officer at the United States Naval Academy; Technical Assistant to the Director of Naval Nuclear Propulsion; Nuclear Officer Program Manager and the Submarine Officer Community Manager on the staff of the Deputy Chief of Naval Operations (Manpower, Personnel, Training, and Education); COMSUBPAC Prospective Commanding Officer Instructor (Submarine Command Course); Chief, Program and Budget Branch on the Joint Staff (J8) Directorate (Program and Budget Analysis Division); and Director, Congressional Liaison Appropriations Matters Office (FMBE) on the staff of the Assistant Secretary of the Navy (FM&C).

He has completed three overseas deployments in Pacific Command and five strategic deterrent patrols in the Atlantic. The units he served with collectively earned four unit awards, five Battle "E"s and the U.S. Pacific Fleet's Arleigh Burke Fleet Trophy.

RDML DAVID GOGGINS, USN

Program Executive Officer for Submarines

Rear Adm. David Goggins is a native of Los Angeles. He attended the University of California, Berkeley, and graduated in 1989 with a Bachelor of Science in Nuclear Engineering and Material Science Engineering. His graduate education includes a Master's of Science in Operations Research from the Naval Postgraduate School and a Master's of Science in Mechanical Engineering from the Massachusetts Institute of Technology.

Goggins' career in the Navy began as a submariner aboard USS Tecumseh (SSBN 628) where he served as an electrical officer, reactor controls assistant and assistant operations officer. He was then selected for lateral transfer to the engineering duty officer community and reported to the supervisor of shipbuilding, conversion and repair (SUPSHIP) in Groton, Connecticut. At this command he was the lead ship coordinator for PCU Connecticut (SSN 22) from initial hull erect to the initial stages of post-shakedown availability planning.

Subsequent shore duty tours included serving as the assistant repair officer at Naval Submarine Support Facility in New London, Connecticut; Seawolf Class project officer and program manager's representative at SUPSHIP Groton; Ohio-class guided-missile submarines (SSGN) Conversion project officer and program manager's representative at SUPSHIP Groton; Virginia Class assistant program manager for new construction within Program Executive Officer for Submarines; and a staff assignment within the Office of Chief of Naval Operations, Undersea Warfare Division (N97).

Goggins also served as an individual augmentee participating in Operation Iraqi Freedom. While in Iraq, he supported the military's counter-IED effort and was responsible for fielding over 3,000 mission critical systems to counter the rapidly evolving IED threat.

Goggins became major program manager of the Virginia Class Program Office in 2012. Under his leadership and guidance, the Virginia Program delivered three submarines to the fleet, started the initial design work on the Virginia Payload Module and Acoustic Superiority and won the Department of Defense Value Engineering Award and the David A. Packard Award for Acquisition Excellence. Goggins was named program manager of a second Major Defense Acquisition Program, the Ohio Replacement Program, in June 2015, now known as the Columbia Class Program.

Goggins became Program Executive Officer for Submarines in August 2018.

His awards include the Legion of Merit (with two gold stars), the Meritorious Service Medal (with two gold stars), the Navy Commendation Medal (with two gold stars) and the Navy Achievement Medal (with two gold stars).

RADM DAVID HAHN, USN

Chief of Naval Research; Director of Innovation, Technology Requirements and Test and Evaluation (OPNAV N94)

A native of Tampa, Florida, Rear Adm. David Hahn graduated from the U.S. Naval Academy with distinction in 1985, earning a Bachelor of Science in Mechanical Engineering. Additionally, he holds a Master of Business Administration from George Mason University and has completed the Massachusetts Institute of Technology Seminar XXI program in International Security Affairs.

Prior to command, he served at sea aboard USS Casimir Pulaski (SSBN 633), USS William H. Bates (SSN 680) and USS Springfield (SSN 761), deploying to the North Atlantic and Western Pacific, as well as conducting several strategic deterrent patrols.

Ashore, he served as flag lieutenant to superintendent, U.S. Naval Academy; squadron engineer, Submarine Development Squadron (SUBDEVRON) 12; action officer, Joint Staff in the Command, Control, Communications and Computers (C4) Directorate; and legislative fellow on the staff of U.S. Senator John Warner.

Hahn commanded the USS Pittsburgh (SSN 720) from September 2003 to January 2007. In command, he deployed to the Caribbean Sea and Pacific Ocean and conducted an Engineered Overhaul in Portsmouth, New Hampshire.

Since becoming an acquisition professional in 2007, he has served as Joint Test and Evaluation test director and program manager, Advanced Submarine Research and Development and served as major program manager, Submarine Combat and Weapon Control Systems program.

Hahn's first flag assignment was as the senior technical advisor to the deputy chief of Naval Operations for Information Warfare/ director of Naval Intelligence (OPNAV N2/ N6).In November of 2016, he became the 26th chief of Naval Research with concurrent flag responsibilities as director, Innovation Technology Requirements and Test & Evaluation (OPNAV N94).

Hahn has been awarded the Defense Superior Service Medal, Legion of Merit, Defense U.S. Navy Biographies - REAR ADMIRAL DAVID J. HAHN Page 1 of 2 Meritorious Service Medal, the Meritorious Service Medal (three awards), the Navy and Marine Corps Commendation Medal (four awards), the Navy and Marine Corps Achievement Medal and various campaign and unit awards.

VADM DAVID JOHNSON, USN

Principal Military Deputy, Assistant Secretary of the Navy for Research, Development and Acquisition

Vice Adm. David Johnson, the son of a Navy captain and a Pensacola, Florida, native, graduated from the U.S. Naval Academy in 1982 with a Bachelor of Science in Aerospace Engineering.

Upon commissioning, Johnson reported to Trident Refit Facility in Bangor, Washington, where he served as docking officer, qualified as ship superintendent at Puget Sound Naval Shipyard and earned his engineering duty dolphins. Johnson graduated from the Massachusetts Institute of Technology in 1989 with a naval engineer degree and a Master of Science in Mechanical Engineering. Subsequently, Johnson held submarine acquisition and repair positions at the Supervisor of Shipbuilding in Groton, Connecticut, as a waterfront coordinator delivering Ohio class submarines and later as the program manager's representative for the Virginia-class submarine; at Trident Refit Facility Bangor as the planning officer; and at program executive officer (PEO) Submarines as the assistant program manager for USS Jimmy Carter (SSN 23).

Johnson became major program manager Virginia Program Office (PMS 450) in 2005. Under his guidance, the Virginia program reduced overall cost by $4 billion and delivered four submarines to the fleet. The program was awarded the 2007 DoD Value Engineering Award and the 2008 David A. Packard Award for Acquisition Excellence. Johnson also established and served as the first Undersea Enterprise chief technology officer.

Johnson's flag tours include PEO Submarines, deputy commander for Undersea Technology (SEA 073), deputy PEO Submarines for the Ohio SSBN Replacement Program and commander, Naval Undersea Warfare Center. In October 2015, he assumed responsibilities as principal military deputy for the Assistant Secretary of the Navy Research, Development & Acquisition.

Johnson has received various personal and campaign awards, including the Defense Service Medal, Legion of Merit and the Meritorious Service Medal with three gold stars.

VADM WILLIAM MERZ, USN

Deputy Chief of Naval Operations for Warfare Systems (OPNAV N9)

Vice Adm. Bill Merz is a native of San Diego, California. He is a 1986 graduate of the U.S. Naval Academy with a Bachelor of Science in Ocean Engineering. He has since earned Master's degrees from The Catholic University of America and U.S. Naval War College.

Merz qualified in submarines as a junior officer aboard USS Haddo (SSN 604). He served as engineer officer aboard USS Boise (SSN 764) and as radiological controls officer aboard USS Proteus (AS 19). He commanded the nuclear powered Deep Sea Vessel "Submarine NR-1", the attack submarine USS Memphis (SSN 691), and Submarine Development Squadron 12. Ashore, he conducted submarine design research in Carderock, Maryland, completed two tours in the Pentagon as a budget programmer on both the Navy Staff (N80) and Joint Staff (J8), served as head of the Naval Reactors "Line Locker", and served as chief-of-staff for Commander, Submarine Forces Atlantic, Task Force 144.

His flag assignments included commander, Naval Mine & Anti-Submarine Warfare Command (NMAWC) and Task Force 77 in San Diego, California; commander, Task Force 54 in Bahrain; commander, Task Force 74 in Japan; and, director, Undersea Warfare Division (OPNAV N97) in the Pentagon. He assumed his current Pentagon assignment as deputy chief of naval operations for Warfare Systems (OPNAV N9) in August, 2017. In this capacity, he is the Navy's lead requirements officer for land, surface, undersea, and air domains, special programs, accelerated acquisition, and urgent operational needs.

Through the course of nine overseas deployments, Merz conducted the full spectrum of submarine operations in support of U.S. Pacific Command, U.S. European Command, U.S. Central Command, and U.S. Africa Command. The crews he served with collectively earned six unit awards, five Battle "E"s, and the Atlantic Fleet's "Battenberg Cup".

CAPT CHRISTOPHER RAMSDEN, USN

Chief of Staff, Patrol and Reconnaissance Group/Pacific

A native of Windham, NH, CAPT Ramsden graduated from Pinkerton Academy and holds a Bachelor of Science degree in Physics from Norwich University (1989) and a Master's of Science in National Resource Management from the Industrial College of the Armed Forces at National Defense University (2008). Additionally, he is a graduate of the Defense Acquisition University's Senior Acquisition Course.

CAPT Ramsden's sea tours include a first tour in Patrol Squadron TWENTY-SIX, Brunswick, Maine, deploying to Roosevelt Roads, Puerto Rico, and twice to Sigonella, Sicily supporting Operations DESERT CALM, SOUTHERN WATCH and SHARP GUARD. A disassociated sea tour aboard USS JOHN C. STENNIS as Operations Administration Officer, Command Security Manager and Officer of the Deck, completing an Arabian Gulf deployment and home port change to San Diego, CA, and a department head tour with Patrol Squadron FIVE, Jacksonville FL where he served as Tactics, Training and Operations Officer during deployments to Keflavik, Iceland and Sigonella, Sicily.

His shore tours include an assignment with Commander, Patrol Wings Atlantic/Task Force Eight Four in Norfolk, Virginia as Flag Lieutenant deploying to Guantanamo Bay, Cuba with JTF-160 during Operation SEA SIGNAL where he assumed the additional duties of Flag Secretary and Personal Security Officer, a shore tour with Patrol Squadron THIRTY as a Fleet Replacement Squadron NFO Instructor and Fleet Training Officer in the newly established Weapons Tactics Unit and a tour with PMA-205/290 in Patuxent River, MD where he served as the Assistant Program Manager for Training Systems (APMTS) for the P-8A Poseidon. Additionally, he served as the Deputy Director for Battlespace Awareness (BA) and BA Functional Capability Board Lead, managing DoD requirements and resources in the BA portfolio for the Joint Staff, J2 in the Pentagon and Vice Chair of the Strategy and Policy Department, U.S. Naval War College, Newport, RI.

His command tours include the "Fighting Tigers" of Patrol Squadron EIGHT deploying in 2006 to the 5th and 7th Fleet AOR's in support of Operations IRAQI FREEDOM and ENDURING FREEDOM, OIC, Task Force FIVE SEVEN (CTF-75) Forward in Manama, Bahrain, and Commander, Patrol and Reconnaissance Wing TWO in Kaneohe HI.

VADM CHARLES "CHAS" RICHARD, USN

Commander, Submarine Forces; Commander, Submarine Force Atlantic; Commander, Allied Submarine Command

Vice Adm. Chas Richard is a native of Decatur, Alabama, and is a 1982 graduate with honors from the University of Alabama. He has earned master's degrees with honors from the Catholic University of America and the Naval War College.

His operational assignments include command of USS Parche (SSN 683) as well as Submarine NR-1, then the U.S. Navy's only nuclear-powered, deep-submergence submarine. He also served aboard USS Portsmouth (SSN 707), USS Asheville (SSN 758) and USS Scranton (SSN 756).

Richard's staff assignments include service as the executive assistant and naval aide to the Under Secretary of the Navy; chief of staff, Submarine Force Atlantic; and command of Submarine Squadron (SUBRON) 17 in Bangor, Washington. Other staff assignments include director of resources, Under Secretary of Defense (Policy); squadron engineer of SUBRON-8 and duty on the Deputy Chief of Naval Operations (Submarine Warfare) staff. He has also served as a member of Chief of Naval Operations' Strategic Studies Group XXVIII, studying the integration of unmanned systems into naval force structure.

Flag officer assignments include command of Submarine Group 10 in Kings Bay, Georgia; director of Undersea Warfare (OPNAV N97), Pentagon, and deputy commander, Joint Functional Component Command for Global Strike at U.S. Strategic Command.

Richard previously served as the deputy commander, U.S. Strategic Command.

Richard assumed his current duties in August 2018. As commander, Submarine Forces, he is the undersea domain lead, and is responsible for the submarine force's strategic vision. As commander, Submarine Force Atlantic, he commands all Atlantic-based U.S. submarines, their crews and supporting shore activities. These responsibilities also include duties as commander, Task Force (CTF) 144, CTF 84; commander, Anti-Submarine Warfare (ASW) Forces Western Atlantic; and CTF 46. As commander, Allied Submarine Command, he provides advice to the North Atlantic Treaty Organization Strategic Commanders on submarine related issues.

He has been privileged to serve on commands that have been awarded the Presidential Unit Citation, Joint Meritorious Unit Award, Navy Unit Commendation, Meritorious Unit Commendation and the Battle Efficiency "E" awards.

ANDREW RICHARDSON

Deputy Commander, Office of Naval Intelligence

Mr. Andrew G. Richardson was appointed to the position of Deputy Commander, Office of Naval Intelligence, and to the Defense Intelligence Senior Executive Service, in March 2018. Immediately prior to assuming his current position, Mr. Richardson served on a' joint duty assignment, beginning in November 2015, as the Assistant Deputy Director of Naval Intelligence, N2N6I, and the Assistant Director of the Naval Intelligence Activity. In that position he was responsible for assisting the Deputy Director of Naval Intelligence in providing intelligence support to Department of Navy senior leaders, oversight and management of Navy intelligence programs and initiatives, and the day-to-day management of the Naval Intelligence Activity.

From October 2006 through February 2018, Mr. Richardson was an employee of the Office of the Director of National Intelligence CODNIJ, and was appointed to the Senior National Intelligence Service (SNISJ) in August 2008. From November 2011 to November 2015, he was the Deputy Director of the Office of Legislative Affairs. In that position he was responsible for advising the Director of National Intelligence and other ODNI senior officers on strategic-level interactions with the U.S. Congress. Mr. Richardson also served as the Director of Policy and Programs for the Associate Director of National Intelligence for Human Capital, where he was responsible for developing and coordinating strategic human capital policies for application to the Intelligence Community. Prior to his appointment to the SNIS, Mr. Richardson served as a senior human capital policy advisor for almost two years.

Prior to joining the ODNI staff, Mr. Richardson worked for over 11 years in the U.S. Congress. From April 1999 to September 2006, he worked for Senator George Voinovich on a subcommittee of the Senate Committee on Homeland Security and Governmental Affairs. In March 2001, he became the staff director of the subcommittee, serving as Senator Voinovich's principal advisor and representative on committee issues. Prior to his Senate employment, Mr. Richardson worked for over four years in the U.S. House of Representatives.

Mr. Richardson received a commission as a reserve intelligence officer in the U.S. Navy in February 2000 and remains active in the reserves.

Currently a Commander, in February 2010 he was mobilized to active duty and served in Basra, Iraq, in support of special operations forces and the U.S. Army.

Mr. Richardson holds a Master of Science degree in Strategic Intelligence from the National Defense Intelligence College (now National Intelligence University), Washington, D.C., and a Bachelor of Arts degree in history from Connecticut College, New London, Connecticut.

CAPT PETER SMALL, USN

PMS-406 Unmanned Maritime Systems

CAPT Pete Small was commissioned in 1995 from the NROTC at the University of Virginia where he earned a Bachelor of Science Degree in Mechanical Engineering. He has also earned a Master of Science Degree in Operations Research in 2002 from Columbia University and a Master of Science Degree in Mechanical Engineering and a Naval Engineer Degree in 2005 from the Massachusetts Institute of Technology. He is a licensed Professional Engineer in the Commonwealth of Virginia.

Upon completion of Navy nuclear propulsion training in 1996, CAPT Small reported to USS L. MENDEL RIVERS (SSN 686) where he conducted dry-deck shelter operations on two deployments to the Mediterranean Sea and Arabian Gulf. He then served as Assistant Professor of Naval Science at the State University of New York (SUNY) Maritime College and Fordham University NROTC.

In 2005, CAPT Small reported to the Supervisor of Shipbuilding Newport News, Virginia where he was the Assistant Project Officer for VIRGINIA Class submarine new construction and two LOS ANGELES Class submarine repair availabilities and completed an Individual Augmentation deployment to HQUSEUCOM in Stuttgart, Germany. From 2008 to 2010 he served as Deputy Ship Design Manager and Aft Project Officer in the OHIO Replacement submarine program office (PMS397.)

In 2010 CAPT Small was appointed Associate Professor of the Practice in the Mechanical Engineering Department at the Massachusetts Institute of Technology and served as the Academic Officer of the graduate Naval Construction and Engineering (Course 2N) curriculum. From 2012-2015 he served as the PMS450 Program Manager's Representative for VIRGINIA Class submarine construction at Supervisor of Shipbuilding Groton, Connecticut and delivered USS NORTH DAKOTA (SSN784) to the Navy.

From 2015-2017 he served as the Assistant Program Manager for Acquisition in the Advanced Undersea Systems Program Office (PMS394) and successfully attained Milestone C and Initial Operational Capability for a Major Defense Acquisition Program. In May of 2017 he reported as the Construction Manager for the COLUMBIA Class Submarine Program Office (PMS397.) In June of 2018 he relieved as Major Program Manager of the Unmanned Maritime Systems Program Office (PMS 406) in PEO Unmanned and Small Combatants. He continues to teach Submarine Concept Design in the MIT Professional Summer program.

CAPT Small's personal decorations include the Legion of Merit, Meritorious Service Medal (three awards), Joint Service Commendation Medal, Navy Commendation Medal (four awards), and the Navy and Marine Corps Achievement Medal (four awards.)

RADM JOHN TAMMEN, USN

Director, Undersea Warfare Division, Office of the Chief of Naval Operations, N97

Rear Adm. Tammen is a native of Washington Township, New Jersey. He graduated from Rensselaer Polytechnic Institute in 1984 with a Bachelor of Science in Mechanical Engineering and earned his Master's degree in Engineering Management from Old Dominion University.

His career as a nuclear submarine warfare officer includes assignments aboard USS Plunger (SSN 595), as a division officer; USS Nevada (SSBN 733) as the engineer officer; and USS Providence (SSN 719) as the executive officer. Subsequent command assignments include commanding officer of USS Georgia (SSBN/SSGN 729), and commodore of Submarine Squadron 19.

Ashore, he has served as officer in charge of Combat Systems Training Team on the staff of Commander, Submarine Group 5; squadron engineer on the staff of Commander, Submarine Squadron 17; Force Nuclear Power officer for the Atlantic Submarine Force; executive assistant to the director Submarine Warfare Division (OPNAV N77); deputy division chief for Joint Capabilities Division (Joint Staff J8); section head for Platforms, Payloads, and Budget in Undersea Warfare (OPNAV N97); military assistant and chief of staff for the Assistant Secretary of Defense for Operational Energy Plans and Programs (OEPP), the Honorable Sharon Burke; and deputy director for Undersea Warfare (OPNAV N97).

As a flag officer, he served as the deputy director, Plans and Policy (J5) at U.S. Strategic Command, and Commander, Submarine Group 9, Naval Base Kitsap, Washington.

Tammen is currently the director, Undersea Warfare Division, Office of the Chief of Naval Operations (N97), Washington, District of Columbia.

His personal decorations include Defense Superior Service Medal (two awards), Legion of Merit (five awards), Defense Meritorious Service Medal, Meritorious Service Medal (two awards), Navy Commendation Medal (five awards), Navy Achievement Medal (two awards), and various unit awards.

TECHNICAL SESSION SUMMARIES

AVIATION

DICASS Noise Analysis

Buratti, R. • Russo, D. • Stone, J.

21445

The goal of this research is to determine the noise gain achievable using the existing Directional Command Active Sonobuoy System (DICASS) in a downward refracting environment. Noise Gain measurement results will be presented for an operationally relevant environment.

Air ASW Systems (PMA-264)

Belvin, D. • Farr, M.

21470

Program roadmap presentation. Discussion of production of current sensor designs, and research and development of future capabilities.

DDVLA Sonobuoy Program Update

Hawkins, D. • Hays, A. • King, W.

21575

Update regarding the DDVLA program and the technology being developed at SLA. As program moves into a Phase II.5 and towards production the SLA and USSI partnership is critical for transitioning this technology into production.

Underwater Target Detection in Hyperspectral Remote Sensing Imagery

Gillis, D.

21631

Hyperspectral imaging (HSI) sensors are imaging systems that measure light over hundreds of wavelengths. In this work, we develop models and algorithms that exploit the information available in HSI data to detect underwater targets in a wide variety of environmental conditions.

C4I

Communications Architectures for C4I in Hostile EM Environments
Steinbrecher, D.
21471
This paper will review new concepts that are evolving to improve the signal dynamic range of wireless RF systems for C4I applications.

Advanced Naval Technology Exercise 2018 Demonstration Overview Cross Domain C3 for Manned/ Unmanned Systems Intelligent Collaboration
Schluderberg, L.
21478
A discussion of Naval C2 BM capabilities from Theater level to Submarines demonstrated in ANTX 2018

Payload Delivery Systems for Advanced Tactical Applications
Powell, D.
21485
A family of payload delivery system (PDS) platforms and technologies expedites the development and operational deployment of specialized payloads from aerial, surface and sub-surface environments. A common PDS technology baseline streamlines host platform integration and certification which provides the warfighter with more rapid access to developments in the areas of C4I, counter measures and electronic warfare.

Utilizing Machine Learning and Data Mining to Improve the Detection Time of Obsolete Parts
Bradley, C. • Love, J. • Summers, D. • Willams, J.
21500
C4I and combat systems explores different aspects of how to advance and support our warfighters through technological advances and/or information. While the immediate introduction of new combat systems has a direct impact on the warfighter, a problem that is rarely considered is how to maintain these systems for years to come. By investigating and potentially mitigating the obsolescence management aspect of combat systems, we can help ensure that these tools will be available for the full projected lifecycle of that system and any expansions that are needed.

Unhackable: A Strategic Framework for Cyber Resilience
Zimmerman, J.
21583
To maintain undersea dominance, the Submarine Force must take a strategy-based approach of developing cyber resilient systems, instead of constantly reacting to the lastest threat or vulnerability.

Machine Learning and Artificial Intelligence in a Network Segmented Architecture
Otero, D. • Sprague, J.
21600
Machine Learning (ML), Artificial Intelligence (AI), and Data Science and Analytics are changing the way Federal agencies approach their respective missions. Network sensors and Internet of Things (IoT) devices are major enablers in how effective these technologies can be within an organization. As the number of network-connected devices continues to grow exponentially, it is imperative that a holistic approach to network security be incorporated to secure and better enable such concepts as ML, AI and data analytics.

Demonstration of a Vehicle-to-Vehicle Optical Pointing, Acquisition, and Tracking System for Undersea Laser Communications
Conrad, S. • Hardy, N. • Howe, T. • Rao, H.
21610
We have demonstrated an all-optical pointing, acquisition, and tracking system that enables robust, gigabit-per-second (Gbps) undersea laser communication between mobile platforms. Additionally, this approach provides precise (cm-class) relative positioning between the communicating parties, enabling relative position, navigation, and timing (PNT) distribution between independent vehicles.

Findings from a Navy-Industry Workshop on Seabed Warfare
Carmona, M. • Eppig, S. • Lademan, J. • Wood, W.
21618
The purpose of this briefing is to present some of the key findings from a Workshop on Seabed Warfare and Undersea Targeting jointly sponsored by PMS 394 and Northrop Grumman Undersea Systems. This event, one of two multi-day workshops, addressed some of the concepts related to maintaining undersea superiority through offensive and defensive seabed warfare, including targeting undersea threats.

Assuring Undersea Dominance Through the Undersea Communications & Integration Program Office
Boone, M.
21623
The Undersea Communications & Integration Program OfficeÕs vision is to assure undersea dominance in an era with evolving threats and quickly changing technologies. To support CNOÕs tenet to ÒStrengthen Our Navy Team for the FutureÓ and address forthcoming challenges of assuring undersea dominance between 2030 and 2070, it is imperative to have a network of integrated capabilities that fosters continuous communication between shore infrastructures and manned, unmanned, and unattended sensors operating on and below the surface around the world.

How Digital Twin and Network Orchestration Keep Training and Technology Moving Forward in Gap Years
Beel, J. • Jones, K.
21630
To stay ahead of the technology curve while doing more with less during a gap year, the Navy will need to move away from an integration model based on complex system interdependencies and hard coded integration toward a framework of atomic systems that can be tested, validated, assembled or disassembled on demand and across multiple locations and in an automated repeatable, reliable way. Digital Twin and Orchestration technologies can help the Navy achieve this goal.

Testing Your Comms System at the Navy's Undersea Data and Power Test Bed
Henson, J. • Lloyd, J. • Traganza, W.
21696
PMS 485 Maritime Surveillance Systems (MSS) is developing a test bed consisting of a seabed-laid data and power distributed cabled network system. Their goal is to advance the development of undersea devices (e.g., acoustic communications modems, laser communications, buoys with RF communications, sensor, etc.) that would take advantage of a common undersea access point and network infrastructure. PMS 485 will detail the MTB concept of employment, to include the initial questionnaire, kick-off meeting, test scheduling, test planning and standard operating procedures (SOP) to interface with the MTB and the MTB support team resources.

RF Machine Learning Signal Classification Performance
Smarrelli, B.
Under several current SBIR and DARPA research efforts, Expedition Technology has developed and tested AI/ML models for RF signal recognition and emitter identification to detect and recognize multiple emitter types, ranging from solid state radars to IoT WiFi devices to satellite telemetry and communication links. Once trained, a ML network model is computationally efficient, not based on libraries, and is able to extract discriminative signal features even at low SNR.

COMBAT SYSTEMS

Rapid Prototyping for Submarine Payload Integration
Moore, K.
21491
The potential and opportunity for new and innovative submarine launched payloads is expanding rapidly, with numerous payloads currently in various stages of concept development and demonstration. This paper will describe a process conducted for recent payload projects that joins technical exploration, system prototyping, and concept of operations development in an iterative, synergistic manner in order to enable rapid transition to tactical applications.

PEO Submarines, PMS 415
Gerstein, R. • Jackson, B. • Jurkiewicz, S. • Ore, V.
21493
Undersea Defensive Warfare Systems Program Office

Undersea Systems Program Office Update
Adams, D.
21533
Overview of the latest developments in IWS 5.0 programs.

A Design for Human-Machine Teaming in Undersea Warfare
Hilger, R. • Roberts, J.
21577
A grassroots-developed strategy to advance human-machine teaming in Undersea Warfare through the systematic development of machine learning and artifical intelligence algorithms. The design advances four lines of effort: 1) Creating a Digital Ecosystem, 2) Developing Applications and Algorithms, 3) Accelerating Implementation, and 4) Developing the Human Team.

Demonstrating Third Party Targeting
Laliberte, C.
21587
Novel methods in distributed targeting will provide submarines with longer arms, allowing fewer submarines to accomplish more from a strike perspective. An ongoing collaboration between the Navy and other agencies to augment distributed targeting has resulted in a series of lab-based experiments, at-sea tests, and changes to submarine architecture ultimately enabling this capability.

Capability to All Boats, All the Time: Beyond the TI/APB Model

Guertin, N. • Schmidt, D.

21590

The Technology Insertion and Advanced Processor Build Model was developed in the mid 90's. The state of the practice has evolved to support a faster and more effective connection between development and operations.

PMS 425 Program Overview

Zettler, G.

21700

Submarine Combat Systems Program Office overview.

Rapid Acquisition via the DIUx

Glassman, J.

21701

PMS 425 experience with Rapid Acquisition via the DIUx

MINE WARFARE

Active Sonar Matched Waveform for Resonant Spherical Mine Target

McCorkle, J. • Romero, R.

21460

he unique frequency response of an undersea channel and undersea target can be exploited to increase detection probability. Using matched illumination techniques, specifically the eigenwaveform and matched illumination, the transmit waveform can be designed to maximize received energy resulting in higher detection probabilities.

ANTX 2018 "Smart" Unmanned Maritime System of Systems for Counter UUV/Mine Warfare Operations

Redman, D.

21473

Collaborative autonomous systems provide "Smart" mine detection and clearing with counter UUV operations

Concepts for MOEs, Risk, and Values of Minefields

Edwards, J.

21475

This presentation will cover concepts of updating current mining measures of effectivenss, introduce new measures of effectiveness, and showcase a decision making tool that compares the risk to delivery platform to the reward of the mining operation.

High-Temperature Superconducting Mine Countermeasures for Unmanned Sea Surface Vehicles

Ferrara, P. • Horne, R.

21511

Modeling results of the next generation High-Temperature Superconducting (HTS) mine countermeasure (MCM) system to increase the capability of MCM operations.

Multi-Spectral IMaging (MSI) Sesnors for Undersea Warfare Missions

Apostolou, M. • Miklas, J. • Randall, J. • Sterchele, R.

21513

The US Air Force has fielded advanced airborne ISR sensor systems proven effective in standoff undersea warfare missions. These systems are the SYERS-2C (flown on the U-2) and the MS-177 (in flight test on the Global Hawk). UTAS will present operational imagery and mission results from these systems in the field.

The First Sonobuoy Launcher Compatible A Sized UUV

Graham, T. • Reynolds, T.

21611

NSWC PCD Investments in MIW

Adair, P. • Everhart, David

21616

This brief will provide an overview of recent accomplishments and future plans specific to mine warfare using Naval Innovative Science and Engineering (NISE) funding at NSWC PCD and from other Naval Research and Development Establishment (NR&DE) partners.

Recent Advances in Synthetic Aperture Sonar Signal Processing

Brown, D. • Gerg, I. • Montgomery, T.

21641

In this presentation, an overview of recent advances in embedded synthetic aperture sonar signal processing will be provided. This research is focused on utilizing Commercial Off the Shelf (COTS) Graphics Processing Units (GPUs) to both accelerate the generation of imagery as well as reduce the hardware footprint associated with supporting sensor operations.

Affordable Man-Portable Synthetic Aperture Sonar Solution for Mine Warfare

Lawrence, D.

21642

Review results of the first integration of the Kraken SAS on a Riptide 1MP for ANTX 2018.

Mine Counter Measures - A Fleet Perspective

Toland, R.

21709

UNDERSEA SENSORS

PMS 485Õs Deployable and Mobile Surveillance Systems Update

Grant, J. • LaShomb, S. • Nehra, M.

21303

This brief details the current activities PMS 485 is managing and its plans for a future Deployable Family of Systems and Mobile Surveillance Systems to support rapid prototyping and production of surveillance systems that are directly focused on meeting gaps in Fixed Surveillance Systems and Surveillance Towed Array Sensor System missions.

Deployment of Novel Underwater Sensors Using UAVs

Paulus, M.

21325

Tracking of underwater targets continues to be a challenging operation, especially in areas where high value systems may be put at risk. This work seeks to leverage emerging sensor technology and small drones to deploy tracking systems.

Design and Modeling of a Compact Correlation Velocity Log for Small UUVs

Blanford, T. • Brown, D. • Meyer, R.

21444

New approaches to acoustic navigation are required for small unmanned underwater vehicles in order to maintain positional accuracy while submerged. Doppler techniques are impractical on small platforms because of the power that is required when they are scaled in size. A new concept for correlation velocity logs allows for compact designs that can be used on small, low cost platforms with the same performance characteristics and lower power requirements than traditional acoustic navigation aids.

2018 Đ The Centennial of our Dominance in the Undersea Domain Đ How It All Began in New London, Connecticut, During ÒThe Great War.Ó

Manstan, R.

21467

A close collaboration between civilian and naval personnel is essential in maintaining dominance in the undersea domain. As this presentation will describe, the necessity for collaboration is as true today as it was during World War I when an Òundersea battlespaceÓ became a reality . . . and the infamous U-boat nearly won the war for Germany.

Underwater Electromagnetic Alternating Signature Model

Schaal, M • Raghavan, S.

21476

We will compare existing underwater electromagnetic (UEM) alternating current models and our newly developed UEM propagation model for a range of frequencies, geometries, and sources. Through a comparison of signature measurements from calibrated source tests over electric and magnetic sensor arrays against model results, we will demonstrate the improved performance of our model especially in cases where the effect of the seafloor is important.

IWS5 Advanced Development Status

Scala, P.

21477

Mr. Scala will provide Sensor and AxB development status update.

Creating a Shallow Water Anti-Submarine Warfare Training Capability with the Installation of the Undersea Warfare Training Range (USWTR) off Jacksonville, FL

Garnett, G. • Reardon, J. • Yinger, P.

21490

Novel Thermal Acoustic Transducer Source in an A-sized Unmanned Undersea Vehicle (UUV)

Carreiro, L. • Howarth, T. • Mayo, N. • Schumacher, C.

21501

Improved Signal Processing for Pulsed Narrowband Waveforms

Blunt, S. • Cuprak, T. • McCormick, P. • Walters, D.

21502

Conventional active narrowband detection is performed with a windowed Fourier Transform resulting in fixed sidelobe levels and the potential for leakage. This briefing demonstrates how adaptive signal processing techniques can be used to improve detection and reduce active clutter for pulsed narrowband sonar.

Underway Ship Hull Inspections Using High-Resolution Imaging Sonars

Pietrzyk, J. • Pitts, J. • Pulsone, N. • Ryu, P.

21544

This research explores the technology needed to conduct fully automated ship hull inspections of underway surface vessels using high-resolution imaging sonars. Algorithms were developed to create 2D and 3D maps of the hull as well as automatically identify and locate objects of interest.

Early History of U.S. Navy Sonar
Straw, T.
21569
The search for German U-boats during World War I led to the research, development and test of a number of underwater listening devices that could be mounted on ships and submarines, and towed from surface ships and air ships. The Naval Experimental Station at Ft. Trumbull in New London and the work done at the Nahant Station in Massachusetts resulted in many innovations in undersea listening capabilities which will be described in the presentation.

NextGen Underwater Electromagnetic Signature Reduction Systems
Holmes, J.
21582
The presentation will briefly describe emerging underwater electromagnetic threats, and outline signature reduction concepts being proposed to counter them.

Interoperable Sidescan Sonar Evaluation
Arrieta, R. • Folts, G.
21594
QinetiQ NOrth America and Naval Surface Warfare Center Panama City Division (NSWC PCD) are developing and demonstrating a new sonar technology that will enable multiple sonars using the same-frequency to operate without jamming each other. This is being demonstrated using two sidescan sonars with the left side and right side acoustic signals overlapping to cover the nadir. This paper will describe current results, status, and plans for the program.

The Effects of DVL Mounting Location on AUV Ego-motion and Pose Estimates
Hacker, K. • Monaco, M.
21599
This research explores the effects of the DVL's mounting location on AUV ego-motion and pose estimates. It finds that, when DVL measurements are integrated into a tightly-coupled framework, most AUVs would benefit from an unconventional DVL placement that is far from the vehicle's center of buoyancy. These findings suggest that the DVL's placement should be considered during the design stages of an AUV.

Rapid Reconstruction and Analysis of At-Sea Data
Andronowitz, K. • Arrighi, A. • Ushkevich, C.
21606
The ability to rapidly reconstruct and analyze SONAR data is critical to provide objective quality evidence to support analysis and evaluation of current and future automated capabilities for SONAR systems. The ÒWeed WackerÓ tool was developed to reconstruct performance of SONAR data and underlying automation. The tool leverages system-level data collected in-situ or in post-test playback and provides the ability to examine display ready data and associated automation.

Multi-Sensor Tracker
Bordonaro, S. • Exley, M.
21607
The Multi-Sensor Tracker is a new tracking capability which is able to utilize measurements from multiple sensors to provide one complete tracking picture. This multi-target tracking allows for targets to be tracked through interfering sources and find and maintain contacts in a very time sensitive problem.

Compact Littoral ASW SONAR for Very Small to Medium USV
Reynolds, T.
21612
Kongsberg Maritime has delivered high frequency ASW SONAR for allies hunting small diesel submarines in the littorals. The SONARs are well suited for our growing USV inventory.

Arctic Diffusive Staircases: An Overlooked Opportunity for Detection?
Davis, J. • Joseph, J. • Radko, T.
21625
Hydrodynamic changes to diffusive staircase structures induced by propagating submersibles may be observable long after staircases are initially disturbed. Developing sensing technologies that can measure the hydrodynamic variability may offer an alternative approach to detection.

Employing Distributed Acoustic Sensing for Infrastucture Protection
Folts, G. • Fry, M.
21626
QinetiQ North America (QNA) has developed a systems approach to protection of distributed seabed infrastructure by employing Distributed Acoustic Sensing (DAS). The DAS approach utilizes optical fiber cabling to provide distributed acoustic measurements along the length of the cable providing passive monitoring and sensing for critical system protection.

(U) Seabed Surveillance System Signal Processing and Automation Modernization
Hatcher, E.
21713
(U) The Advanced Capabilities Roadmap Integrated Product Team (ACR-IPT) has identified desired areas for technical development in signal processing and automation as part of their FY20-FY25 project roadmap for undersea surveillance. This brief seeks to improve industry awareness of needed technologies and improve technical partner engagement.

New Textured Piezoceramic Materials
Fuoco, L. • Hill, C. • Lee, W.
21719
Textured piezoelectric materials for which exhibit extraordinary piezoelectric responses similar to single crystals and can be produced at a much higher yield, with greater compositional uniformity for the next generation of sensors.

Affordable Mobile ASW Surveillance System
Fischer, T.
21726
ONR is pursuing development of an affordable mobile ASW Surveillance System. This presentation will describe areas where industry can assist ONR in addressing technical challenges.

UNDERSEA VEHICLES

Defining VIRGINIA Class Block VI Within the Context of the Tactical Submarine Evolution Plan
Nagy, D.
21479
The Block VI VIRGINIA Class design that will be done within the context of TSEP will allow the Navy to explore, characterize, and define new ways the manned submarine will operate within a future manned and unmanned system of systems.

Unmanned Undersea Vehicle (UUV) Requirements Group (URG) Capability Needs and Priorities
Klinedinst, B.
21480
OPNAV N97 representative to brief the Undersea Vehicle technical session on the outcome of the Unmanned Undersea Vehicle (UUV) Requirements Group (URG) 2018 Capability Recommendation Letter.

Design and Analysis of Swarming Architecture for Unmanned Systems in Air, Sea, and Space Environments Using Goal Oriented Requirements Engineering.
Douglas, A.
21481
A method is proposed to use goal oriented requirements engineering to help design the ability for swarming architectures to satisfy multiple mission needs in the applicable environment.

Subsea and Seabed Warfare Initial Capabilities Document
Rezzo, D.
21482
N97 is sponsoring an Initial Capabilities Document to document capability requirements and associated capability gaps pertinent to the subsea and seabed warfare. The ICD, upon Department of the Navy and Joint Staff Validation, will serve as a precursor to an analysis of alternatives for solutions to close the capability gaps and inform system requirements for follow-on Capability Development Documents and Capability Production Documents for the next generation of SSW systems.

Tailored Network Architectures for Sonar Image Classification
McKay, J.
21483
Neural network models have dominated optical image classification problems in recent years. This talk looks to provide insight into how such models can be tailored towards sonar image classification.

DARPA Project: Positioning System From Deep Ocean Nodes
Dorfman, Y. • Kofford, A. • Waterston, J.
21486
Ocean node-based systems that provides PNT for UUVs without need to surface for GPS.

Advanced Naval Technology Exercise (ANTX) Human Machine Interaction 2018 (HMI-2018)
Delgreco, N. • Hardro, P.
21499
The Advanced Naval Technology Exercise (ANTX) 2018 is a collaborative event that took place at the Naval Undersea Warfare CenterÕs Narragansett Bay Test Facility in Newport, RI, in collaboration with the Southeastern New England Defense Industry Alliance and partnership with the Commander, Naval Meteorology and Oceanography Command (CNMOC) in Stennis, Mississippi.

Progress Towards Multidisciplinary Design Optimization for Contemporary Stealth
Jones, M. • Paterson, E.
21514
From the perspective of submarine design, hydrodynamic signatures have previously been largely ignored. This work aims to fold this component into a broader multi-disciplinary design optimization framework that can account for all known signatures. The Reynolds-averaged Navier-Stokes equations are solved in the near wake of a self-propelled submarine in a stratified environment with variations in design parameters to consider their individual contributions.

Employing Untethered Transformational Capabilities in Denied Subsea Environments

Fry, M. • Goldman, H. • Radford, N.

21524

QinetiQ North America (QNA) and Houston Mechatronics Inc. (HMI) have teamed to explore employment of the HMI Aquanaut vehicle for forward deployed operations in a contested environment. Employing QNA's advanced LPI/LPD long distance communications and no-nadir (gap) search sensor with the transformable vehicle provides the operators untethered long distance work class capability

Air Independent, PEMFC Power System for Marine Applications

Miller, M. • Sievers, R. • Utz, R. • Wynne, R.

21588

Long duration, marine capable power systems are needed for a range of operations on the sea floor, ROV and UUV platforms. Air independent fuel cell systems are being designed and developed for these platforms. Prototype in water testing is underway.

Integration and Application of Lasers on Submarines

Friend, D. • Gormley, J. • Kendall, M. • Perry, M.

21615

Equipping submarines with a high energy laser weapon would make each submarine more lethal and more survivable. Taking advantage of recent advances, preliminary work will be presented showing integration of a weapons-grade laser into a Virginia-class submarine.

Progress on Affordable UUV Swarms

DiBiaso, D. • Goldberg, D. • Parry, J. • Smith, J.

21617

Draper and Riptide have combined their capabilities to move affordable UUV swarms forward . They are on a trajectory to make these advances available to the DoD community of interest, enabling new CONOPS in undersea warfare. This briefing provides an overview and results of recent efforts

Physics of Surface Piercing Bodies

Delaney, K. • Fullerton, A.

21624

Many of the Navy's undersea vehicles (manned and unmanned) operate at or near the free surface in order to meet mission requirements. During near surface operations the vehicle's antennas (communications), masts (visualization), and/or snorkel (air exchange) may pierce the ocean's surface. As such, it is important to be able to accurately model and understand the physics of surface piercing bodies to inform the Navy of the vehicle's performance during these operations.

Development of a Navy Safety-Certifiable Critical Battery Management System

McCaig, R. • Ramanujam, N.

21629

There is a growing need for high energy storage systems using Lithium-ion batteries to power Navy weapons and platforms. However, given the risk of catastrophic failure from these batteries, there is also a critical need for a Navy safety-certifiable battery management system. We present some lessons learned from our ongoing development of a critical battery management system for the Navy.

Feasibility of Fuel Cell Centric Power Modules for LDUUV and Other Submersibles

Blunk, R. • Fuller, B. • Wise, D.

21632

This project undertook to design and build a land based demonstration of a PEM fuel cell power module for a system representative of an LDUUV. The performance of the unit in a demonstration conducted at the Energy Campus of Colorado State University is described.

Design, Development and Integration of a Payload Delivery Section Enabling Long-Transit and Multiple Payload Delivery at Precise, Pre-define Locations by a UUV

Clark, G. • Lebo, W. • Raymond, T.

21633

This presentation discusses the analysis and design of a payload delivery UUV section compatible with the GDMS Bluefin 21 Unmanned Underwater Vehicle (UUV). This payload delivery section would allow the UUV to carry multiple payloads of various sizes for long transits prior to delivery at precise, pre-defined locations, including payloads such as Sonobuoys, Sandshark™ UUVs, UAVs, etc. with the ability to carry multiple payloads on a given mission and deliver specific types based on mission plan.

Protecting Naval Assets in Port with Autonomous Swarming AUVs

Albert, C. • Appler, J. • McNelly, B.

21637

This presentation will introduce and discuss alternatives to underwater threat detection within the waterfront environment, and will provide specific details for a swarming autonomous underwater vehicle (AUV) system currently under development at the Johns Hopkins University Applied Physics Laboratory (JHU/APL). The system will use cooperative, high-dynamic, multi-sensor AUVs to provide protection of naval assets in harbors and while in port. To perform detection, classification and interdiction the AUVs must have autonomy, navigation, control, sensing, and communication capabilities.

Merits of Advanced Materials for Future Submarine Propulsor Development

Ma, J. • Taylor, P. • Vlattas, J.

21638

Successful U.S. Navy Submarine propulsor designs require a balance of multiple, often competing objectives. New material technologies could expand the design trade space. Several ongoing projects are defining this trade space and are setting the stage for use of advanced materials in undersea vehicles propulsor design to great effect.

Unmanned Undersea Vehicles and COTS Use

Gaetanos, N. • Strong, C.

21639

COTS parts have significant drawbacks for use on high reliabitlity systems. For XLUUV in particulary they will lead to significant added risk with respect to meeting the reliability, acoustic and efficiency requirements.

Hybrid Reynolds-Averaged Navier Stokes/Large-Eddy Simulation (HRLES) of Buoyant Jets in Stratified Liquids

Martin, C. • Paterson, E.

21640

688 Quick Look Study Ð Achievable Capability Insertions for Life-Extended LOS ANGELES-Class Ships in the SSN Gap Years

Bowe, K. • Neblett, E.

21646

A summary of concept design studies performed to add advanced capabilities to LOS ANGELES class submarines during SSN gap years and de-risk future new attack submarine designs. Studies cover a wide range of options from minimal technology insertions to large-scale capability additions.

Technology Development for Lithium ion Battery Platform Certification

Fontaine, J. • Wartelsky, M. • Winchester, C.

21647

Program update on Submarine lithium ion certification effort including system designed to detect battery casualty to allow for mitigation.

Testing Your UUV at the Navy's Undersea Data and Power Test Bed

Henson, J. • Lloyd, J. • Traganza, W.

21695

PMS 485 Maritime Surveillance Systems (MSS) is developing a test bed consisting of a seabed-laid data and power distributed cabled network system. Their goal is to advance the development of undersea devices (e.g., acoustic communications modems, laser communications, buoys with RF communications, sensor, etc.) that would take advantage of a common undersea access point and network infrastructure. PMS 485 will detail the MTB concept of employment, to include the initial questionnaire, kick-off meeting, test scheduling, test planning and standard operating procedures (SOP) to interface with the MTB and the MTB support team resources.

A Seabed Warfare in Denied Waters Demonstration at ANTX 2018

Conaway, B. • Lindman, R. • Somlyody, S.

21705

A presentation of the UUV based seabed warfare demonstration presented at ANTX 2018 by Huntington Ingalls Unmanned Maritime Systems and partners Advanced Acoustic Concepts and Battelle. The demonstration included execution of an entire kill chain to transit into denied waters, enter a battlespace and locate and identify a seafloor target, engage and destroy the target, and exit the battlespace. The demonstration utilized key technologies available and in the water today.

UUV Core Technologies

Iera, R.

21718

The Navy is pursuing Core Technologies for UUVs across Five Lines of Effort & Objectives: Endurance, Autonomy & Precision Navigation, Command, Control, and Communications (C3), Payloads & Sensors, and Platform Integration

WARFIGHTER PERFORMANCE

User Centered Design in the Acquisition Lifecycle

Mestre, O. • Ogren, L.

21496

Naval Undersea Warfare Center Division Newport (NUWCDIVNPT) has developed a process to incorporate Human Systems Integration (HSI) considerations into programs entering or already in the Acquisition Lifecycle. This iterative process has aided projects in developing a better understanding of user or operator needs, software interface design, and how to incorporate HSI requirements into the overall system design.

A First Look at VRSUB and the Future of Virtual Reality Training

Crafford, T. • Moskalski, T.

21518

Virtual Reality Submarine Trainer (VRSUB) is the next evolution of shore-based trainers that offers a safe and controlled virtual environment for realistic harbor navigation. VRSUB is a joint effort between warfare centers that is still in development. We will provide an overview of the program along with insights into the future of virtual reality training systems.

SSBN Submarine Warfare Federated Tactical Systems (SWFTS) Modernization

Corser, M.

21597

This presentation will cover the training and system capability benefits provided to the SSBN submarine warfighter through recent SWFTS modernization efforts. The associated benefits to the COLUMBIA Class baseline will also be addressed.

Common Electronic Toolset for Submarine Qualification and Training.

Adilinis, G. • Kessel, P. • Laiter, C. • Simms, S.

21621

Nosis is an integrated set of software applications whose purpose is to improve warfighter readiness and performance.This paper will present the phased approach being used by the Nosis team to achieve a true integration of the disparate products resulting in a common toolset for submarine Qualification and Training

SPEAKING SITES

Plenary Session

1 Dealey Center Auditorium . . . . . (B.164)
(no general parking available)

Technical Sessions

1 Undersea Sensors (Dealey Auditorium) . . . . . (B.164)
1 Undersea Vehicles (Dealey Classroom) . . . . . (B.164)
2 Undersea Sensors (Room 317) . . . . . (B.83)
2 Mine Warfare (Room 319) . . . . . (B.83)
2 Aviation (Room 327) . . . . . (B.83)
2 Combat Systems/Warfighter Performance (Room 318) (B.83)
3 Undersea Vehicles (Bledsoe Hall) . . . . . (B.499)
4 C4I (Lewis Hall) . . . . . (B.474)

Clambake

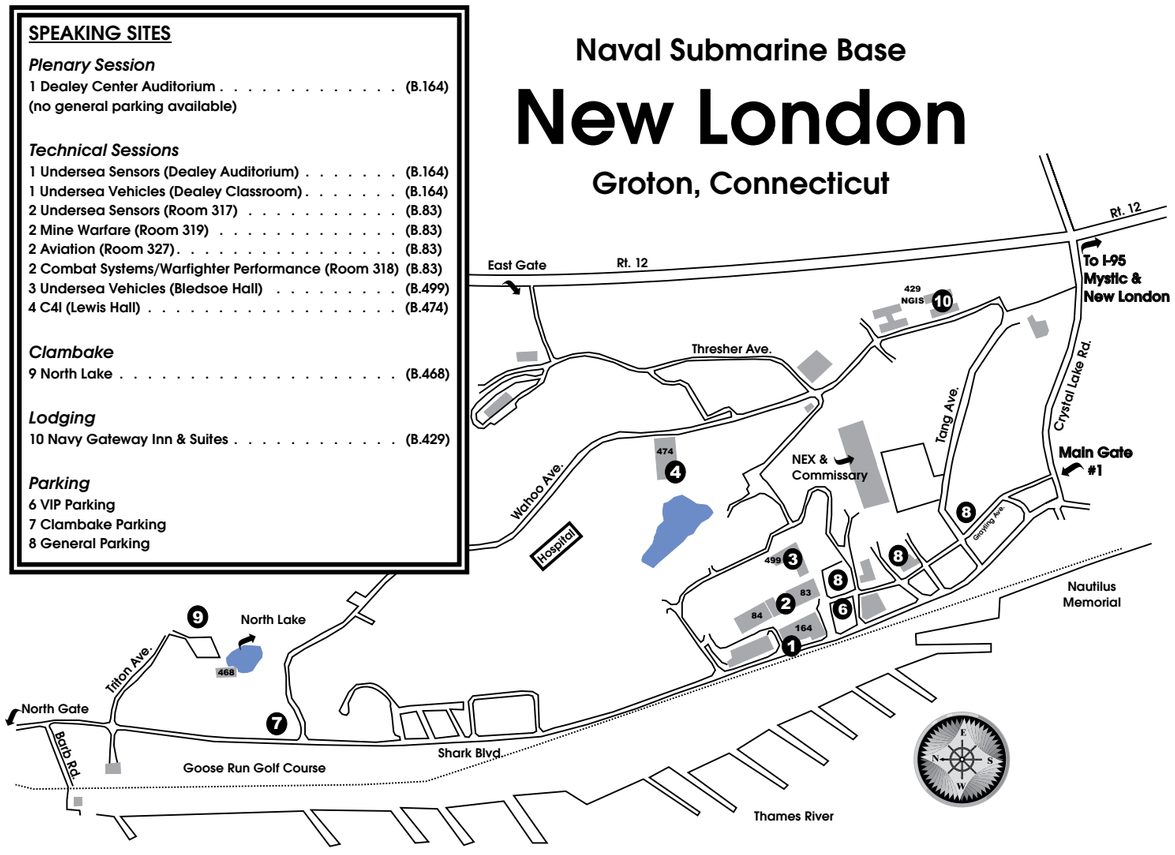
9 North Lake . . . . . (B.468)

Lodging

10 Navy Gateway Inn & Suites . . . . . (B.429)

Parking

6 VIP Parking
7 Clambake Parking
8 General Parking



BUS SCHEDULE

Due to heightened security measures, it is in your best interest to take the shuttle buses provided. The use of POV is strongly discouraged and may result in entry delays and the risk of not being allowed access.

TUESDAY, SEPT 18

6:30 – 9:00 am Buses will shuttle (as filled) from the hotels (Mystic Marriott, Hilton Garden Inn and Hampton Inn) to the Dealey Center Auditorium

10:00 am – 4:00 pm

Bus departs the Dealey Center Auditorium for the Hotels (Mystic Marriott, Hilton Garden Inn and Hampton Inn) every hour.

Shuttle will depart Dealey Center Auditorium at:
10 am | 11 am | 12 pm | 1 pm | 2 pm | 3 pm | 4 pm

4:45 – 5:45 pm

Buses will shuttle in a loop from the Dealey Center Auditorium to the Hotels (Mystic Marriott, Hilton Garden Inn and Hampton Inn)

5:45 – 7:00 pm

Buses will shuttle in a loop from the hotels (Mystic Marriott, Hilton Garden Inn and Hampton Inn) to the Clambake

8:00 – 9:30 pm

Buses will shuttle from the Clambake to the Hotels (Mystic Marriott, Hilton Garden Inn and Hampton Inn). Drop-offs only.

WEDNESDAY, SEPT 19

6:30 - 9:00 am

Buses will shuttle from the Hotels (Mystic Marriott, Hilton Garden Inn and Hampton Inn) to the Dealey Center Auditorium

10:00 AM - 4:00 pm

Bus departs the Dealey Center Auditorium for the Hotels (Mystic Marriott, Hilton Garden Inn and Hampton Inn) every hour.

Shuttle will depart Dealey Center Auditorium at:
10 am | 11 am | 12 pm | 1 pm | 2 pm | 3 pm | 4 pm

5:00 - 6:30 pm

Buses will shuttle from the Dealey Center Auditorium to the Hotels (Mystic Marriott, Hilton Garden Inn and Hampton Inn). Drop-offs only.

BREAKOUT SESSION BUS SHUTTLE

(to Lewis Hall and Building 439, Grenfell Hall Classroom)

7:30 am – 5:30 pm

Buses will run a circular route between Dealey Center Auditorium and Lewis Hall every 15 minutes beginning on the hour.

REGISTER TODAY

21ST ANNUAL SYSTEMS ENGINEERING CONFERENCE

This conference will focus on improving acquisition and performance of Defense programs and systems, including system - of - systems engineering, systems security, net-centric operations and data/information interoperability, and all aspects of system sustainment.

October 22 – 25, 2018

Grand Hyatt Tampa Bay

Tampa, FL

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