2020
UNDERSEA WARFARE
VIRTUAL CONFERENCE

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AVIATION SYSTEMS

MQ-9B SeaGuardian Anti-Submarine Warfare

Peter Yelle
Strategic Development Manager,
General Atomics Aeronautical Systems

The MQ-9B SeaGuardian with its anti-submarine warfare (ASW) payload offers a unique maritime operational capability inherent in no other Unmanned Air System (UAS). The ability to deploy and monitor sonobuoys autonomously from a medium altitude, long endurance UAS significantly enhances remote submarine detection and tracking and at a significantly reduced cost over manned platforms for U.S. Maritime Component Commanders and partner nations.

C4ISR

Improving Data Interference Quality and Analytics with Trusted Provenance and Systems Interoperability

Eleanor Mitch
CEO and Founder, 14BIS Supply Tracking

The safety and success of every Navy mission relies on quick, reliable access to the right data for decision-making. But key systems challenges—inadequate asset authentication, insecure data and systems that grow increasingly complex and disparate—are causing vulnerabilities, fueling delays and compromising safety. Technological advances may be used to improve big data multimodal data fusion, integrity and decision-making.

Ethical Control of Unmanned Systems

Donald Brutzman
Naval Postgraduate School

Lethality requires an ethical and legal basis for armed conflict, supervised by military teams. Well-structured executable robot tasking using mission goals and constraints can resemble tactical tasking of humans afloat. Careful application of Semantic Web technology makes syntactic verification, semantic validation and ethical control of unmanned systems feasible.

Remote Function Select, an Extensible Self-Describing Command and Control Interface for Deployable Systems

Dr. David Powell
CTO and Chief Engineer, Sparton Deleon Springs LLC

Remote Function Select (RFS) forms the basis for a suite of technologies providing a lightweight command, control and communications capability for use in deployable systems such as sonobuoys, cross-domain communication gateway buoys, micro UAVs, etc. RFS is an extensible, self-describing protocol allowing the host command and control system discovery of all configurable settings on the RFS-enabled device without having any a-priori knowledge of the device. This capability provides significant cost benefits and speeds the introduction of new technologies and capabilities to the fleet.

Evolving Undersea Communications

Ron Jones
Deputy Program Manager and Subject Matter Expert, OpalSoft NUWC Keyport Support Service

Anthony Niznik
Senior Director, Projects, OpalSoft NUWC Keyport Support Service

Presenting a concept to implement virtualization for Naval C4I systems.

Zero Trust Networks: From Principles to Practice

Daniel Moniz
Technical Staff, Naval Undersea Warfare Center

Zero trust networking is a security concept that is gaining greater interest in both the commercial and military sectors as a more effective approach than traditional perimeter security techniques. While the concepts and goals of zero trust networking are well described, there has been little guidance or description available about how to deploy these techniques. This presentation will outline zero trust concepts and examine the protocols and software that can be used to deploy them.

Model Based Systems Engineering in the Product Support Environment

Lucas Marino
Integrated Logistics Support Manager/Product Support Strategist

Dr. Kaitlynn Castelle
Life Cycle/Product Support Strategist

Applications of model based systems engineering (MBSE) provide a more capable support system for the future warfighter. Digital models of vessels will integrate with robust and centralized repositories of engineering and logistics data to improve maintenance planning, supply chains, and the operational and materiel availability of the nation's most critical seagoing assets.

COMBAT SYSTEMS

Data Analytics for Predictive Maintenance in an Industrial Environment

Jonathan Hahn
Senior Data Scientist, World Wide Technology, Inc.

Utilizing Operational Exercises for the Conventional Prompt Strike Program to Develop Prototypes to Rapidly Transition Capabilities to the Warfighter

Matthew O'Connell
Payload Systems Engineer, NUWC NPT

The Conventional Prompt Strike program is a top priority within the Department of Defense to develop hypersonic missile capability and deploy to the warfighter before our adversaries. Using fleet operators and real world scenarios, prototypes are developed to inform requirements, evaluate concepts of operations, and transition capability rapidly to tactical systems. This discussion topic outlines the process and insertion points that can be applied to acquisition programs in order to deliver systems on schedule and within budget.

MINE WARFARE

Counter-UUV Systems

Matthew Searle
Chief Technology Officer, Maritime Arresting Technologies

The advance of unmanned underwater vessel technology makes the possibility of encountering self-propelled smart mines much more likely. A lot of attention has been given to defeating UAVs and autonomous surface vessels but we can't overlook the threat from below.

UNDERSEA SENSORS

Effects of Acceleration and Maneuvering of a Submarine on the Dynamics, Persistence, and Detectability of its Wake

LT David Kramer, USN
Naval Postgraduate School

In order to counter increasingly quiet adversarial submarines as well as understand the vulnerabilities to non-acoustic methods of detection for allied submarines, the Naval Postgraduate School is utilizing numerical simulations to analyze the effects of acceleration and maneuvering on the dynamics and thermodynamic signatures of sub-surface wakes. Such maneuvers create clearly identifiable changes and asymmetries in the wake field, which we characterize by its magnitude, width, and duration.

Standards for Subsea/Seabed Warfare Systems

Chelsea Meggitt
Oceanetics, Inc.

Dallas Meggitt
Sound & Sea Systems, LLC

The successful integration of disparate subsea and seabed warfare (SSW) technologies and systems will depend to a significant extent on the development and utilization of a broad range of standards to define interfaces, communications, power and related elements of these systems. Many SSW concepts and systems utilize various configurations of Undersea Distributed Networks (UDNs) as an integral part of the overall system concept. This presentation discusses the need for, and development of standards applicable to UDNs for SSW.

Research in Non-Linear Applications

Richard Katz
Senior Research Engineer, Naval Undersea Warfare Center

Dr. Dirk Huges
Senior Research Engineer, Naval Undersea Warfare Center

This research summarizes advancements performed at NUWC-NPT in nonlinear acoustics for Navy and commercial (dual-use) applications.

Update on Aluminum-Water Energy Modules for Static & Dynamic Applications

David Porter
General Manager, L3 Open Water Power

Andrew Jesmain
Senior Manager, Business Development, L3 Harris

Don Aubrecht
Director, Systems Engineering, L3 Harris

OWP is maturing and de-risking a variety of core and supporting technologies related to aluminum-water (Al-H2O) batteries for UUVs and subsea and seabed warfare (SSW) systems—e.g. sensors, C2—that offer the safety, endurance, and longevity at deep ocean depths to transform current undersea warfare concepts of operation. OWP will update USW Virtual Conference attendees on its recent advances in UUV endurance, sea-bottom deployment of static energy modules, and dormancy.

ML-PDA and ML-PMHT Comparison for Estimating VLO Targets in Multipath Underwater Environment

Dr. Peter Willett
Professor, Electrical & Computer Engineering, University of Connecticut

Christopher Franzini
University of Connecticut

Francesco Palmieri
University of Connecticut

Yaakov Bar-Shalom
Board of Trustees Distinguished Professor & Marianne E. Klewin Endowed Professor of Engineering, University of Connecticut

We compare two approaches to target detection and parameter estimation in a Very Low Observable (VLO) underwater multipath environment, and two methods: Maximum Likelihood Probabilistic Multiple Hypothesis Tracking (ML-PMHT) and Maximum Likelihood Probabilistic Data Association (ML-PDA). The two approaches differ in their multi-path data association philosophies and models, with the latter more precise but much more demanding in computation. Is the performance worth the cost? This work is part of ONR's NIUVT program at UConn and URI.

UNDERSEA VEHICLES

Active Terrain Aided Navigation

Darren Kurt
Nuclear Submarine Officer, U.S. Navy

Active Terrain Aided Navigation (ATAN) is a new approach for conducting accurate navigation without reliance on external beacon systems. It is an information theoretic software framework that seeks the dual purpose of ensuring complete coverage of a designated area while minimizing positional estimation errors. The approach uses a near-real time Artificial Intelligence Reinforcement Learning approach that results in a dynamic trajectory optimization that balances Exploration and Exploitation mission objectives. This talk will present an overview of the approach that will include simulated initial results.

Submarine Auxiliary Waterjet Propulsion

LT Benjamin MacFarland, USN
Student, Mechanical Engineering, Naval Postgraduate School

Dr. Walter Smith
Consultant, Propulsion, Gas Turbine, and Energy Evaluations, LLC

Many underwater vehicles draw sea water in and out for various reasons, such as cooling hot equipment or sampling sea water. The inlets and outlets are typically normal to the hull (i.e. the flow is exiting athwartships, rather than aft). This is wasted flow energy that could be used to propel the ship. A stationary device could be placed on the outlet to both redirect and nozzle the flow, in effect turning the sea water flow into a form of waterjet propulsion. Very little research has been done regarding waterjet propulsion for underwater vehicles. Research has been done determining the nozzle outlet diameter that maximizes thrust based on the pump being used, as well as the most efficient nozzle shape. These are for conventional waterjet propulsion systems on surface ships, which use an axial pump, but the principles can still be applied to this study. Research has also been conducted for surface ship waterjet propulsion on interactions of the waterjet system with the hull of the ship. This will be applicable to this topic, since higher velocity fluid will be exiting the nozzle and will interact with the hull, yielding excessive drag. The use of an ejector will also be investigated to maximize propulsion.

The main objective of this thesis is to investigate the feasibility of redirecting and nozzling the sea water flow, from athwartships to aft, using available excess energy from the ship to provide a useful means of emergency/auxiliary propulsion. In support of this, a secondary objective will be to determine the most efficient design to both redirect the flow, roughly ninety degrees, while nozzling the flow to maximize propulsion. This method of auxiliary propulsion will attach stationary devices to the Main Sea Water outlets to both redirect and nozzle the flow to provide useful propulsion. This has not been attempted before. I think it will work due to the fact that the Main Sea Water Pumps require roughly the same amount of electrical power as the outboard, which can be used for propulsion in emergencies. The devices are designed to maximize thrust while minimizing head loss in order to help meet cooling requirements of the system.

These devices will allow submarines to have an auxiliary form of

propulsion in the event of a casualty that precludes use of the propeller/propulsor. Secondly, in the event of an attack to the stern of the ship (i.e. torpedo exploding near the propeller), the outboard could also be unusable due to its close proximity to the propeller. Since these devices are not near the propeller, they could still provide propulsion for the ship. Thirdly, since SSBNs typically patrol at very slow speeds, these devices could provide a method for them to routinely patrol without use of the propeller/propulsor. Lastly, if unmanned undersea vehicles are ever propelled by nuclear power in the future, these devices could be used as the sole means of propulsion, rather than requiring main engines, a shaft, and a propeller. All of these applications support the mission of Integrating Subsea/Seabed Warfare Capabilities by providing an alternate method of low speed propulsion for both large and small underwater vehicles.

In the interest of keeping my thesis UNCLASSIFIED, the majority of the research is done using the DARPA SUBOFF model. Assumptions were made to determine the Main Seawater System design flowrate, so that attainable speed could be determined. Multiple sized devices were designed in Solidworks, and Computational Fluid Dynamics (CFD) simulations were run in ANSYS-CFX. A SECRET portion of the thesis will be conducted, using a Virginia-Class Submarine.

Research in this topic is still fairly new. An analytical solution has been completed. All CFD simulations, both UNCLASSIFIED and SECRET, will be complete in time for the NDIA conference, and an experiment will most likely be conducted to validate the CFX models.

The results of all CFD simulations run up to this point yield an attainable speed of approximately 10 kts for the SUBOFF model. These simulations do not include use of an ejector, which will augment the thrust of these devices. I expect all further CFD results and experimental data to agree with this, for the SUBOFF model. I do not expect speeds in excess of 5 kts for simulations run using the Virginia Class Submarine. Even if only 5 kts is attained, this is still a useful speed, especially considering that it is attained without use of the propulsor.

Mission Autonomy Architecture for Unmanned Maritime Vehicles

Dr. Arjuna Balasuriya
Senior Scientist, Charles River Analytics

Bryan Loyall
Principal Scientist and Director of Technology Innovation, Charles River Analytics

Ross Eaton
Senior Scientist, Charles River Analytics

Derek Theyer
Vice President, Decision Management Systems, Charles River Analytics

A novel mission autonomy architecture for unmanned maritime vehicles. Discussion on the architecture and implementations on three types of unmanned maritime vehicles.

VALOR ROV: Reaching Beyond its Class to Change the Way We Keep Our Waters Safe

Alasdair Murrie
Head, Remotely Operated Vehicles Sales, Seatronics Inc.

VALOR reaches well beyond its class, harnessing its small form factor and unrivaled power and payload capabilities to provide flexibility and adaptability to whatever scenario is presented. It also provides the user with one of the most capable Mine Identification & Destruction System (MIDS) available, in addition to multiple other Defence & Security applications. Additionally, VALOR can be fitted with NBC detection sensors, magnetometer, P.A.N Disruptor for mine or IED neutralization and fitted with manipulator arms for delivery of UXO placement charges, etc.

Demonstrating the Effects Web of Non-Conventional UUVs in the "Last Mile," with Implications for the Gray Zone

David Shane
Technical Program Manager and Business Development Lead, Advanced Systems Group, Boston Engineering Corporation

Boston Engineering's non-conventional underwater vehicles can transform traditional UUV tasking based upon vehicle maneuverability and ease of payload integration and deployment, providing a range of potential effects in the "last mile." In this brief, we review these non-conventional UUVs, our next generation profiling devices, the collaboration between the two in a VSW OPAREA, and provide a preview of a demonstration thereof (our own small ANTX) to follow later this year.

WARFIGHTER PERFORMANCE

The Team-Based Advanced Resilience Accelerator (TARA) System: A Tablet-Based Observational Performance Asset Tool that Streamlines the Training Process and Enhances the Development of Resilient Teams

Dr. Lisa Lucia
Aptima, Inc.

Kristy Kay
Scientist (I/O Psychologist), Aptima, Inc.

Jeffrey Beaubien
Distinguished Principal Scientist and IRB Chair, Aptima, Inc.

Resilient teams are critical for safe and effective submarine operation and, more broadly, for multi-domain mission performance and readiness. The Team-Based Advanced Resilience Accelerator (TARA), a tablet-based observational performance assessment tool, was developed for Naval Submarine Base New London's Submarine Learning Center for use in their piloting and navigation simulation trainer. Currently under evaluation by end-users (instructors and trainees), TARA is expected to reduce the administrative and cognitive burden on instructors, improve the team training processes, and ultimately result in enhanced development of resilient teams.

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Our Pride Runs Deep: A Virtual Showcase of the Naval Submarine Medical Research Laboratory (NSMRL)

Dr. Ben Lawson
Technical Director, Naval Submarine Medical Research Laboratory

This presentation will be a guided tour of the Naval Submarine Medical Research Laboratory (NSMRL). The guided virtual tour will include brief presentations and demonstrations of important knowledge and materiel products the laboratory develops to support submariner and diver health and performance.

AI Models of Humans to Support Human-Machine Teams

Dr. Alexander Stimpson
Chief Scientist, ASSETT

Future Human-Machine Teaming paradigms leveraging AI-based intelligent team members will require the AI agents to have some understanding of the capabilities, goals, and situational understanding of their human counterparts to promote trust and team performance. This research examines the strategies for developing AI models of human operators in computer-based environments to enable AI-based team members improved understanding, flexibility, and responsiveness to other team members.