

# **A Selected Bibliography of US Coast Guard RDT&E Branch Area Topics**



**DTIC-TR-2021-02**

**Distribution Statement A**

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**Introduction:**

The RDT&E program for the U.S. Coast Guard enhances acquisition and mission execution by helping transition new technologies into the service's operational forces. The program also provides Coast Guard leadership with knowledge necessary for making strategic decisions. This selected bibliography provides U.S. Government sources related to the U.S. Coast Guard FY21 RDT&E branch topic areas for the FY 21 portfolio. Included are Distribution A Technical Reports found in the DTIC collection.

**How this selected bibliography is organized:**

This selected bibliography was created by using Technical Reports in the Defense Technical Information Center's repository and also Congressional Research Service Reports. The summaries are arranged by the branch areas in the FY21 RDT&E portfolio and then arranged in descending order by date. For access to the papers, simply place the accession number (AD) in the search box at <https://search.dtic.mil/#/>, or, for members of the public [www.discover.dtic.mil](http://www.discover.dtic.mil).

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## Introduction:

The U.S. Coast Guard’s RDT&E program office is vital to its acquisition effort and is responsible for managing applied RDT&E experimentations and demonstrations. The program is constantly innovating and incorporating the top initiatives from across the Coast Guard. At any given time, the RDT&E program is working on more than 80 research and innovation projects that support Coast Guard requirements across all mission areas. RDT&E programs fall into five main program areas:

- Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR)
- Environment and Waterways (E&W)
- Modeling and Simulation Center of Expertise (MSCOE)
- Surface
- Systems and Unmanned Technology

This paper is an annotated bibliography intended to highlight relevant research that supports the FY21 RDT&E efforts of new project for the U.S. Coast Guard found in DTIC Distribution Statement A technical reports authored or funded by the department of defense (DOD) or other federal agencies. The date range of the TRs are 2015-01-01 to 2020-11-01. Arrangement is by program area with two indices: project number and project name. Each bibliographic entry shows the technical report title, accession number, date of publication, distribution number, individual author, corporate author and an abstract.

## Aviation

Project # 2021-01 - Advanced Maritime Counter-Unmanned Aircraft System (C-UAS) Technologies

<b>Drone Defense System Architecture for U.S. Navy Strategic Facilities</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1046916	2017-09-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Arteche, David, Chivers, Kenneth, Howard ,Bryce, Long, Terrell, Merriman, Walter, Padilla, Anthony, Pinto, Andrew, Smith, Stenson, Thoma, Victoria	
<b>Corporate Author:</b>	Naval Post Graduate School Monterey, CA	
<b>Descriptors:</b>	drones, naval shore facilities, unmanned aerial vehicles, data fusion, threats, systems engineering, computer programs, simulation, scenarios, decision support systems, Situational Awareness	
<b>Identifiers:</b>	UAS (unmanned aerial systems), C UAS (counter UAS), TEWA (threat evaluation and weapons assignment), Storm Shield C UAS system, software architecture, ExtendSim, sensitivity analysis, CONOPS (concept of operations)	
Small, commercially available unmanned aerial systems (UAS) are an emergent threat to Navy continental U.S. (CONUS) military facilities. There are many counter unmanned aerial system (C-UAS) tools focused on neutralization, and many sensors in place. A system-of-systems, defense-in-depth approach to C-UAS requires a central system to connect these new and existing systems. The central system uses data fusion and threat evaluation and weapons assignment (TEWA) to properly address threats. This report follows a systems engineering process to develop a software architecture for that central system, beginning with a requirements analysis, a functional baseline, and the resulting		

module allocation. A series of simulations in ExtendSim derives the performance requirements by examining the overall C-UAS scenario with currently available technology. Through a sensitivity analysis, the simulation shows that effective engagement range (combination of initial target range, detection range and neutralization range) is the dominant factor driving response time. The architecture modeled in Innoslate provides a discrete event simulation for system performance expectations.

<b>Counter-UAV Solutions for the Joint Force</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1037984	2017-04-06	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Priasler, David J.	
<b>Corporate Author:</b>	Air War College, Air University Maxwell United States	
<b>Descriptors:</b>	unmanned aerial vehicles, DRONES, air force, THREATS, Countermeasures	
<b>Identifiers:</b>	UAV(unmanned aerial vehicle)	
<p>The recent commercial sales explosion of small, low cost UAV's has renewed discussions amongst security professionals and leaders at all levels of government concerning the threats presented by drones. For well over a decade, these concerns have been presented, discussed, admired, and assessed numerous times. However, a new urgency exists as negligent owners, criminals and terror organizations have realized the capabilities of these devices and are using them in deadly ways. Small-UAV's, which include both remote controlled model aircraft and drones, have been on the commercial market for decades. However, they (specifically quadcopters or drones) have proliferated in staging numbers over the past few years driving renewed concerns and governmental regulations. While the sales figures are impressive, the capabilities of these devices to be used as surveillance and reconnaissance platforms as well as payload delivery vehicles are even more concerning. These capabilities when coupled with their inherent portability and an operator with evil intentions have proven to be deadly. Fortunately, military and commercial organizations have searched for a means to deal with these small, slow, stealthy devices. Further, several systems have proven to be rather successful in defeating these small-UAV systems and have been employed at various civic and sporting events to monitor and deter potential threats from small-UAV's. As these counter-UAS systems have been developed and tested with success, the joint force must act quickly to choose an agile acquisitions model to procure and employ these weapons systems for the protection of property, assets and personnel. In complimentary fashion, the concept of operational employment of these weapons systems must also be agile and responsive to the evolving threat.</p>		

## **C5I (Command, Control, Communications, Computers, Cyber, & Intelligence)**

Project# 2021-01 - Modernizing Law Enforcement Encounter Background Checks at Sea

<b>Expanding the United States Coast Guard's Role within the Indo-Pacific Theater of Operations</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1105370	2020-05-10	Distribution Statement A. Approved for public release. Distribution is unlimited.

<b>Author:</b>	Farr, Scott L.
<b>Corporate Author:</b>	Naval War College Newport RI,
<b>Descriptors:</b>	Department of Defense, Coast Guard, South China sea, law enforcement, Coast Guard Operations, Coast Guard personnel, maritime security, strategy, theater level operations, operational readiness, Coast Guard ships, cooperation
<b>Identifiers:</b>	Indo Pacific, operational footprint, gray zone, theater security cooperation, cutter, rules based order, capacity
<p>The Department of Defense is evaluating how to expand its Indo-Pacific presence in the era of great power competition. The Department's theater strategy report outlines a range of efforts for preparedness, promoting a networked region, and partnerships to achieve the United States' vision for a free and open Indo-Pacific. As the Department shifts its focus to the Pacific to maintain the United States influence, what should the Coast Guards role be within the Indo-Pacific region? Currently, the Coast Guard has only contributed to a limited role in supporting the Department of Defense objectives. Research findings indicate that by using white cutters instead of gray warships, the Coast Guard could help the Department achieve its objectives by lowering the risk of escalation. To expand the United States presence in the Indo-Pacific region, the Coast Guard should increase its operational footprint overseas, dissuade maritime gray zone activities, and improve theater security cooperation to preserve the international rules-based order. Finally, the paper draws conclusions concerning the use of the Coast Guard and recommends further assistance to Pacific island nations. By supporting the development of their capabilities and increasing capacity, they can protect their sovereign interests and defend against threats in the region.</p>	

<b>Designate Maritime Security Response Teams as United States Northern Command's Maritime Crisis Response Force</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1084340	2018-06-15	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Gaudio, Christjan C.	
<b>Corporate Author:</b>	Army Command and General Staff College, Fort Leavenworth	
<b>Descriptors:</b>	United States Northern Command, combatant commanders, homeland security, maritime security, Coast Guard, unified combatant commands, Department of Homeland Security, law enforcement, Special Forces, homeland defense, interagency coordination, special operations forces	
<b>Identifiers:</b>	USNORTHCOM (United States Northern Command), WMD (Weapons of mass destruction), SOF (Special Operations Forces), MSRT (Maritime Security Response Team), TACLET (Tactical Law Enforcement Team)	
<p>This thesis uses Army Force Management processes to outline the development of the Coast Guard's Maritime Security Response Team and advanced interdiction capabilities. Using the Capabilities Based Assessment Process, this thesis builds upon the development of the Maritime Security Response Team and explores United States Northern Command's need for a designated Maritime Crisis Response Force. By outlining the future joint operating environment and conducting functional area analyses, functional needs analyses and a functional solution analysis the thesis builds to its conclusion with the capabilities-based assessment recommendation on the need for the United States</p>		

to have a crisis response unit focused on domestic maritime incidents and capable of supporting special mission units when directed by National Command Authority.

**Thinking through the Unthinkable - How Help from an Unlikely Source Will Strengthen Capacity and Reduce Terrorist Threats in and Around the Straits of Malacca and Singapore**

<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1067820	2019-01-08	Distribution Statement A. Approved For Public Release. Distribution Unlimited.
<b>Author:</b>	Carter, Alex	
<b>Corporate Author:</b>	Asia-Pacific Center for Security Studies Honolulu United	
<b>Descriptors:</b>	geography, southeast Asia, United States government, terrorism, information systems, national security, predictive analytics	
<b>Identifiers:</b>	Not available	

This paper describes how the United States government can help Singapore’s Information Fusion Center identify, target, and eliminate or reduce the threat of maritime terrorism in the Straits of Malacca and Singapore (Straits). The geography of the Straits and the volume of shipping trade that passes through its waterways make the Straits a prime target for terrorists, and an ongoing security concern for the Indonesian government. Despite coordination, joint patrols and even local maritime information centers amongst partner nations, there remains much to improve Indonesia’s security posture and counter-terrorism capabilities in and around the Straits. Jakarta’s concern over the Straits, and its nearby ports, is no different than another mega city that struggles with similar terrorist threats and challenges within its own ports and waterways New York City. In New York, the agency charged with preventing terrorist attacks is a law enforcement one, the New York City Police Department, whose officers and analysts could share their knowledge, specifically in predictive analytics, to stop terrorist threats in Indonesia’s back yard. Such assistance will benefit both parties facing terrorists that plan and operate globally, but strike locally.

**Project # 2021-04 - Mission-Specific Long-Range Communication Analysis**

**Relay Signal Combination to Improve Long Range Communication with Multiple Relays**

<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1059479	2018-08-07	Distribution Statement A. Approved for public release. Distribution is unlimited..
<b>Author:</b>	Heide, David A., Cohen, Aaron E., Moran, Thomas M.	
<b>Corporate Author:</b>	Naval Research Laboratory Washington United States	
<b>Descriptors:</b>	communications techniques, line of sight, measurement, radio frequency, artificial satellites, radio equipment, aircrafts, airborne, transmitters, simulations, communication systems, unmanned aerial vehicles,	
<b>Identifiers:</b>	RELAYS, communications channels, signal combination, signal synchronization, ELS (extend line of sight)	

This report documents a long-range communications technique involving a single transmitter, multiple redundant relays, and baseband signal-combining at the receiver. In this approach, the transmitter broadcasts to a cluster of inexpensive, airborne relays which re-broadcast the same signal on different frequencies. Distant receivers combine multiple weak signals and time-align them to

improve the overall channel bit error rate. This research show that the robustness of a beyond line of sight communications link can be improved without relying on satellites, piloted aircraft, or expensive drones by leveraging multiple relays with minor enhancements to existing radio systems by improving their receiver capabilities.

<b>HF Digital Radio Mondiale (DRM) Broadcast Summary Report</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1061702	2018-04-30	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Gonin, Irene M., Dahlen, Aaron P., Shafeian, Hessamoddin, Johnson, Gregory W., Grayson, Christopher	
<b>Corporate Author:</b>	Coast Guard New London Ct New London United States	
<b>Descriptors:</b>	radio communications, digital communications, High Frequency, Arctic Ocean, situational awareness, field tests, marine navigation, coast guard	
<b>Identifiers:</b>	DRM(Digital Radio Mondiale), NSI(Navigation Safety Information), NAVTEX, NAVDAT, ANSIS(Arctic Navigational Safety Information System), MSI(Maritime Safety Information), eMSI (electronic Marine Safety Information)	
<p>Digital Radio Mondiale (DRM) is a broadcasting technology that has the potential to disseminate electronic Maritime Safety Information over a wide geographical area. In this report, the Coast Guard Research and Development Center (RDC) presents a Concept of Operations (CONOPS) describing how a single DRM transmitter can provide coverage for the Arctic. The report outlines the methodology upon which the CONOPS is based including an Arctic field test conducted by the RDC in which user feedback and field test data were collected. The test proves that the HF DRM prototype offers an affordable and reliable alternative to distribute navigation safety information. Since the prototype infrastructure is comprised of the existing Coast Guard assets (e.g. USCG HF Transmitters and HF antennas) and proven Commercial-Off-The-Shelf products (e.g. DRM content server, modulator and receiver), the total cost of the prototype is relatively low. In addition, the report investigates how the coverage may be expanded to the contiguous United States and Hawaii. It concludes with specific recommendations for future work required to transition the technology to a public service to the mariner.</p>		

<b>Quantum Communication Using Macroscopic Phase Entangled States</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1004896	2015-12-10	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Franson, James D.	
<b>Corporate Author:</b>	University of Maryland at Baltimore County Baltimore United States	
<b>Descriptors:</b>	Secure communications, Quantum key distribution, photons, cryptography	
<b>Identifiers:</b>	entangled, DARPA, quantum communications	
<p>This final report describes the accomplishments of the program after 36 months of funding. A new long-range QKD protocol was proposed and its security was investigated. A pulsed Sagnac interferometer for single-shot phase shift measurements was investigated but not completed due to technical difficulties. Other methods for producing single-photon nonlinear phase shifts were investigated. Randomly-chosen unitary transformations were used to decrease the mutual</p>		

information available to an eavesdropper. Several nonlinear effects were demonstrated using metastable xenon in a high-finesse cavity, including a nonlinear cross-phase shift. The nonlinear phase shifts were enhanced. Other techniques for long-range secure quantum communications were investigated based on the use of a small amount of shared prior key.

### Long Range Acoustic Communication in Deep Water

<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA618119	2014-09-30	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Song, H. C., Hodgkiss, W. S.	
<b>Corporate Author:</b>	Scripps Institution Of Oceanography La Jolla Ca Marine Physical Lab	
<b>Descriptors:</b>	acoustic communications, arrays, deep water, long range(distance), towed arrays	
<b>Identifiers:</b>	Not available	
Develop and experimentally confirm robust self-adaptive algorithms for coherent communications between a source and a towed array at very long ranges in deep water. Experimentally confirm that robust coherent acoustic communication is feasible between a source and receiving array at speed and depth at long ranges in deep water with separations as long as 2000 km.		

### Initial Investigation of a Novel Passive HF Radar Technique Using Available DRM and Data Signals

<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1060621	2013-09-09	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Underhill, M. J.	
<b>Corporate Author:</b>	Underhill Research Limited Lingfield United Kingdom	
<b>Descriptors:</b>	PASSIVE RADAR, signal processing, Software Defined Radios	
<b>Identifiers:</b>	DRM spectra, DRM (Digitale Radio Mondiale)	
Digitale Radio Mondiale (DRM) signals have properties that allow extraction of aircraft distance and velocity passively at distances of up to 1500km, or more depending on the DRM type. The DRM spectra are flat and typically 10kHz wide. Aircraft velocity and approximate distance can be found from the interference patterns created by the direct and reflected waves received from a distant DRM transmitter as observed in a software radio SDR waterfall spectrum/time display of the received DRM spectrum. Up to three aircraft can typically be observed visually by eye. Data FAX signals having a flat 2.5kHz spectrum can be also used when DRM signals are not available. More accurate and improved ranges for more aircraft should be possible with proposed second stage FFT and radar tracking DSP algorithms operating on the received waterfalls. At HF ionospheric reflections provide a long distance OTH capability. The ionospheric multipath can be removed by suitable processing techniques. Some fundamental information theoretic performance limits of this novel technique are examined for the case of a single receiver with an omnidirectional antenna. Aircraft direction and position can to some extent be inferred from flight profile constraints. Better positioning is obtained by combining the information from Data or DRM transmissions on more than one frequency and from different locations. Phased array reception gives target direction for single frequency DRM illumination, at		

some increase in cost and complexity. ADS-Bvirtual radar plots provide data on local civil aircraft movements that can be compared with the DRM waterfall data for algorithm development in this novel passive radar technique.

<b>Long Range, Coherent Synthetic Aperture Communications</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA542076	2012-01-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Song, H. C., Kuperman, W. A., Hodgkiss, W. S.	
<b>Corporate Author:</b>	Scripps Institution Of Oceanography La Jolla Ca Marine Physical Lab	
<b>Descriptors:</b>	acoustic communications, synthetic aperture sonar, algorithms, sound transmission, communication and radio systems, frequency division multiplexing, underwater acoustics, ocean environments, deep water, underwater sound, sonar receivers, north pacific ocean, acoustic arrays, long range(distance), long range(time), signal processing	
<b>Identifiers:</b>	SAC (Synthetic Aperture Communications), ATOC (Acoustic Thermometry Of Ocean Climates), thermometry, LRAC (Long Range Acoustic Communications), OFDM (Orthogonal Frequency Division Multiplexing), HLA (Horizontal Line Arrays)	
The central effort of this research will be the development of robust and reliable algorithms for coherent acoustic communications at very long ranges in deep water. We will study coherent synthetic aperture communications (SAC) between a source and a receiver at speed and depth that exploits the relative motion between the two.		

<b>Modeling the Effect of Internal Waves on Long-Range Propagation</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA542086	2010-09-30	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Henyey, Frank S.	
<b>Corporate Author:</b>	Washington University Seattle Applied Physics Lab	
<b>Descriptors:</b>	internal waves, long range(distance), wave propagation, sound transmission, acoustic velocity, low frequency, underwater sound, ocean models, Philippine sea, parabolas, acoustic waves, mathematical models, underwater acoustics	
<b>Identifiers:</b>	PE(Parabolic Equations), CTD(Conductivity Temperature Depth), LOAPEX (Long Range Ocean Acoustic Propagation Experiments), spice fluctuations, Garrett Munk spectra, spice(Small Scale Propagation Of Internal Waves)	
This project aims to understand the fluctuations in low frequency (100 Hz, for example) acoustical propagation in the ocean over long distances (50 km to thousands of km.), as well as other effects of internal waves and other small-scale variability in the speed of sound. OBJECTIVES The objective is to model results of recent low-frequency, deep-water acoustic-propagation experiments, constraining the model environment from the measurements of those environments. Phenomena such as intensity fluctuations and deep arrivals are of more concern than travel time fluctuations, as the physics of travel time fluctuations is much better understood. APPROACH This project has concentrated mostly on the analysis of environmental data to separate the physical processes leading to sound speed		

fluctuations, and then to use semi-empirical models of these processes for acoustic propagation calculations. Small-scale internal waves and "spice" are the processes of concern for predictions of fluctuations of intensity and spatial correlations and of the deep arrivals. CTD (conductivity, temperature, depth as measured by pressure) profiles are used to extract the small-scale internal waves and "spice". PE (parabolic equation) calculations have been used up until now to simulate the acoustics, but mode equation techniques are superior for some purposes.

**AquaOptical: A Lightweight Device for High-rate Long-range Underwater Point-to-Point Communication**

<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA527463	2010-06-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Doniec, Marek, Vasilescu, Iuliu, Chitre, Mandar, Detweiler, Carrick, Hoffmann-Kuhnt, Matthias, Rus, Daniela	
<b>Corporate Author:</b>	National University Of Singapore	
<b>Descriptors:</b>	underwater communications, optical communications, transmitter receivers, robots, radio broadcasting, Singapore, communication and radio systems, short range(distance), architecture, acoustic communications, information transfer, optical properties, computer programs, long range(distance)	
<b>Identifiers:</b>	Foreign Reports	
<p>This paper describes AquaOptical, an underwater optical communication system. Three optical modems have been developed: a long range system, a short range system, and a hybrid. We describe their hardware and software architectures and highlight trade-offs. We present pool and ocean experiments with each system. In clear water AquaOptical was tested to achieve a data rate of 1.2Mbit/sec at distances up to 30m. The system was not tested beyond 30m. In water with visibility estimated at 3m AquaOptical achieved communication at data rates of 0.6Mbit/sec at distances up to 9m.</p>		

**Project#2020-20 - High Frequency (HF) Radar #2020-20**

**Omnistatic High Frequency Surface Wave Radar: Architecture and Applications**

<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1060643	2013-09-19	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Marrone, Peter	
<b>Corporate Author:</b>	Rob Dobson and Associates Adelaide Australia	
<b>Descriptors:</b>	radar signals, antenna arrays, waveforms, waveform generators, surface waves, target tracking, radar, linear arrays, arrays, radar equipment, radar cross sections, antennas	
<b>Identifiers:</b>	HFSWR (high frequency surface wave radar), MIMO(multiple input, multiple output), TS (Transmit Subsystem), RS (Receive Subsystem)	
<p>This paper describes an "Omni static" high frequency surface wave radar (HFSWR) that can use a single array of antennas on a single site or be deployed over two or more sites. The term Omni static is used to indicate it can be deployed and operated as a conventional monostatic or bistatic</p>		

	HFSWR or over multiple sites implementing a multistatic configuration. The HFSWRs architecture uses multiple input, multiple output (MIMO) techniques to provide some distinct advantages in operational performance and deployment flexibility. The paper also proposes and considers some applications for Omni static HFSWRs using possible local deployment scenarios.
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<b>Altitude and RCS Estimation with Echo Amplitude in Bistatic High Frequency Surface Wave Radar</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA621436	2013-07-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Kongrui, Zhao, Changuin, Yu, Congjian, Zhou, Taifan, Quan	
<b>Corporate Author:</b>	Harbin Institute of Tech (China)	
<b>Descriptors:</b>	bistatic radar, altitude, china, estimates, high frequency, target echoes	
<b>Identifiers:</b>	bistatic high frequency surface wave radar, RCS estimation model, centralized fusion estimation	
<p>It is difficult to form a narrow beam on elevation in the high frequency band. As a result, high frequency surface wave radar (HFSWR) is traditionally unable to detect the target altitude information. Under the bistatic T/R-R HFSWR configuration, an altitude and radar cross sections (RCS) estimation model is proposed with the target echo amplitude information. With four measurement vectors, centralized fusion estimation is adopted to improve the estimation accuracy of target altitude and RCS. Geometrical Dilution of Precision (GDOP) of altitude and the drawbacks of geometric method are also analyzed. Simulations demonstrate the effectiveness of the presented estimation model.</p>		

<b>Data Fusion Performance of HFSWR Systems for Ship Traffic Monitoring</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA615551	2013-07-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Maresca, Salvatore, Braca, Paolo, Hostmann, Jochen	
<b>Corporate Author:</b>	Centre for Maritime Research and Experimentation La Spezia (Italy)	
<b>Descriptors:</b>	data fusion, radar tracking, water traffic, doppler systems, false alarms, high frequency, kalman filtering, mathematical filters, multisensors, ocean surveillance, performance(engineering), probability, sea clutter, ships, situational awareness, surface waves, target detection	
<b>Identifiers:</b>	HFSW (high frequency surface waves), real data, MSA (maritime situational awareness), OTH (over the horizon), UKF (unscented kalman filter), OSCFAR (ordered statistics constant false alarm rate), AIS (automatic identification system), MSMTT (multisensor systems)	
<p>In Maritime Situational Awareness (MSA), low power High-Frequency Surface-Wave (HFSW) radars fit the role of long-range early-warning tools by virtue of their over-the-horizon (OTH) coverage. Unfortunately these sensors, developed mainly for ocean remote sensing applications, exhibit poor range and azimuth resolution, high non-linearity and significant false alarm rate due to clutter and</p>		

interference. For these reasons, the Joint Probabilistic Data Association (JPDA) logic, followed by the Unscented Kalman Filter (UKF), is proposed. Then, to exploit two simultaneously operating HFSW radars with overlapping fields of view, a track-to-track association and fusion (T2T-A/F) logic is applied. The capabilities of the JPDA-UKF tracking algorithm in combination with the T2T-A/F strategy are evaluated using a set of purpose-defined performance metrics, such as the time-on-target (ToT), the false alarm rate (FAR) and the root mean square error (RMSE). Special attention is paid to the comparison of the JPDA-UKF with the 3D (range-azimuth-doppler) Ordered Statistics Constant False Alarm Rate (OS-CFAR) detection algorithm. A procedure based on track length modelling for the analysis of true and false tracks is presented as well. Single-sensor and multi-sensor tracking performances are investigated using real data collected during the NATO Battlespace Preparation 2009 (BP09) HF-radar experiment, which took place between May and December 2009 in the Mediterranean Sea. Ship reports from the Automatic Identification System (AIS) are used as ground truth information. Experimental results are reported and discussed.

<b>Bi-Static and Multi-Frequency Experiments of HFSWR</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA527318	2010-06-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Menelle, M., Jangal, F., Bazin, V., Lecoq, D., Auffray, G.	
<b>Corporate Author:</b>	Office National D'etudes Et De Recherches Aeronospaciales Cedex (France) Dept. Of Systems Control And Flight Dynamics	
<b>Descriptors:</b>	continuous wave radar, search radar, surface waves, aerospace systems, reliability, wave propagation, configurations, laboratories, benefits, statics, surveillance, targets, economics, frequency, high frequency	
<b>Identifiers:</b>	HFSWR (high frequency surface wave radar)	
High Frequency Surface Wave Radar is currently a well-known surveillance system for the Exclusive Economic Zone. We are still trying to improve their performances and reliability. In this new research step, we are trying to assess the benefits of multi-static as well as multi-frequency configuration. The global ambition is obviously to overcome clutter issue and to increase the coverage for small target. Results presented here highlight the significant contribution of the proposed configuration.		

<b>Impulsive Noise Excision and Performance Analysis</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA539817	2010-05-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Lu, X., Wang, J., Ponsford, A. M., Kirilin, R. L.	
<b>Corporate Author:</b>	Raytheon Canada Ltd, Waterloo (Ontario)	
<b>Descriptors:</b>	high frequency, noise(radar), radar interference, impulse noise, surface waves, radar equipment, Doppler systems, excision, time series analysis, performance(engineering), performance tests, symposia, experimental data, Canada	
<b>Identifiers:</b>	foreign reports, HFSWR (high frequency surface wave radar), blanking(signal processing), radar noise	

Interference can be a major impediment to the operational performance of radar systems. A common source of interference is impulsive noise which may appear due to regional lightning discharges or local man-made noise sources. Impulsive noise is characterized as having a large amplitude and short duration and therefore only affects a small portion of the time series. Unpredictable frequency distortion may occur during the impulsive noise period, which is partially caused by the non-perfect response of the receiver front end. In this paper we present several linear prediction methods that are used to remove the impulsive noise without introducing frequency leakage over the signal band. Theoretical performances are analyzed and compared for these methods. The effectiveness of prediction methods relative to traditional excision techniques are also demonstrated using experimental data.

<b>Mode-Selective OTHR: A New Cost-Effective Sensor for Maritime Domain Awareness</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA539232	2010-05-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Frazer, G. J., Meehan, D. H., Abamovich, Y. I., Johnson, B. A.	
<b>Corporate Author:</b>	Defence Science And Technology Organisation Edinburgh (Australia), Intelligence Surveillance And Reconnaissance Division	
<b>Descriptors:</b>	radar, cost effectiveness, beam forming, tracking, marine transportation, adaptive systems, architecture, Australia, distortion, ocean environments, apertures, awareness, naval vessels(support), ionospheric disturbances, ionospheric propagation, symposia, automatic transmissions, propagation, steering	
<b>Identifiers:</b>	OTHR (over the horizon radar), foreign reports, mode selective, over the horizon radar, MIMO (multiple input multiple output), MIMO RADAR, adaptive radar transmitter, ship detection, e layer, maritime domain awareness, MPA (maritime patrol aircraft), HFSWR (high frequency surface wave radar), AIS (automatic identification system)	
<p>This paper presents a new sensor concept designed to provide maritime domain awareness over large ocean areas. The Mode-Selective OTHR introduced herein achieves significant detection and tracking capability against maritime vessels relative to traditional OTHR designs because it is designed specifically to reject disturbed ionospheric propagation modes and operate only using low distortion propagation modes. The architecture of the radar is such that this rejection occurs for both the transmitter-to-surveillance-footprint and the footprint return-to receiver propagation paths. This is achieved using recently discovered techniques for non-causal adaptive and range dependent transmit beamforming and two-dimensional apertures for both transmission and reception. It also includes new methods for using planar transmit arrays operating with extreme steer angle.</p>		

## Environment and Waterways (E&W)

Project# 2021-20 Behavior of Diluted Bitumen (Dilbit) in Fresh Water

(Oil Spill Liability Trust Fund & Great Lakes Restoration Initiative funding)

<b>Oil Sands Products Spill Response</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD11065404	2020-08-19	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Fitzpatrick, Michele, Balsey, Alexander	
<b>Corporate Author:</b>	Coast Guard New London, CT	
<b>Descriptors:</b>	environmental protection, fuel oils, north America, mixing, brackish water, physical properties, seabed, petroleum, environment	
<b>Identifiers:</b>	Dilbit (Diluted bitumen), mitigation system, moving sunken oil, barrier, inland, offshore, spill response, heavy oil, GLRI(Great Lakes Restoration Initiative), Kalamazoo River, Lake Huron, non-floating oil	
<p>U.S. Coast Guard Research and Development Center (RDC) conducted research on response improvements to non-floating oil spills since 2008, when it carried out projects to identify, design, and test new methods for detecting and responding to sunken oil and oil suspended in the water column. RDC began its oil sands products (OSP) Spill Response Project in 2014 with an assessment to determine transportation risks, research and development efforts by other organizations, and potential response gaps with respect to OSP spills. Next, RDC developed a prototype to sample an oil/silt mixture on the bottom of a water body. RDC then evaluated the recovery of weathered OSP in fresh water using a drum skimmer and brush skimmer to determine if any issues related to OSP recovery differed when fresh water was involved. Finally, RDC developed and tested three separate prototypes designed to mitigate the impacts of OSP spilled in moving water in the inland and offshore environments. This report contains results of the RDC research along with information from parallel efforts by other organizations. The report serves as a resource for Federal On-Scene Coordinators in planning for OSP spill responses in both fresh and salt waters.</p>		

<b>Mitigation of Oil Moving Along the Waterway Bottom</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1086872	2019-11-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Balsley, Alexander	
<b>Corporate Author:</b>	Coast Guard, New London CT	
<b>Descriptors:</b>	oil spills, environment, petroleum, environmental protection, lessons learned, coast guard, Bitumens, guy wires, environmental management, environmental pollutants, environmental restoration and remediation, great lakes	
<b>Identifiers:</b>	Dilbit, mitigation system, moving sunken oil, barrier, inland, offshore, spill response, heavy oil, GLRI(Great Lakes Restoration Initiative), Kalamazoo River, Lake Huron, non-floating oil, oil sands	
<p>In 2016, the U.S. Coast Guard (USCG) Research and Development Center (RDC) determined a need to advance the science of spill response technologies for non-floating, or sunken oil. Since 2017, RDC</p>		

designed, fabricated, and tested underwater barrier systems that can mitigate the adverse impacts of moving, sunken oil along the bottom of inland and offshore environments as well as large lakes. Mitigation is achieved by containing the spread of oil on the bottom and deflecting it to a collection area for recovery, or away from sensitive areas. RDC tested two different inland mitigation systems in the Kalamazoo River in April 2018 and April 2019, and an offshore mitigation system in Lake Huron in May 2018. For each mitigation system prototype, RDC explored several different anchoring, deployment, and retrieval methods. RDC also monitored each system for position, motion, sag, scour, and tension. RDC deployed the mitigation systems in areas of low to high current velocities in both the Kalamazoo River and Lake Huron. In this compilation report, RDCs summaries, conclusions, and recommendations for future research are provided with respect to the prototypes developed.

<b>Underwater Sediment Sampling Research</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1035048	2017-01-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Hanson, Alfred, Young, Robert, Hannigan, Brian, Morin, Michael	
<b>Corporate Author:</b>	SAIC Mystic, United States	
<b>Descriptors:</b>	bitumens, hydrocarbons, sampling, SEDIMENTS, OIL SPILLS, test and evaluation	
<b>Identifiers:</b>	dilbit (diluted bitumen), diluents, TPH (total petroleum hydrocarbon), Texas Raw Crude, Turner Designs Cyclops 7, pore water, Dexsil PetroFlag Test Kit, SOMS (Sediment Oil Measurement Systems), underwater sediments	
<p>The USCG R and D Center sought to develop a bench top system to determine the amount of total petroleum hydrocarbons (TPH) in underwater bottom sediment in situ. As a bench top system, this design would not have meet all of the final requirements needed for a fully deployed system, but the concept allows preliminary evaluation in a laboratory setting. This scenario can occur whenever oil is weathered and mixed with silt or sand. The result is that the oil sticks to the silt and sinks to the bottom. Poles were used to agitate the bottom during the Kalamazoo River spill in 2010 and the detection measure of the oil locations was whether sheening did or did not occur. Currently, the only reliable method to determine the exact concentration is to obtain a full sample and perform an analysis in a laboratory. During the Deepwater Horizon spill response, a large amount of samples were needed because oil only comprised about 10-20 percent of the tar mats and were sometimes very scattered. The approach here is to sample the interstitial water between the grains of sand and attempt to determine the amount of oil in and on the surrounding particles. This effort focused on locating diluted bitumen (Dilbit), due to limited response experience with Dilbit spills. However, the study sought a system that could also be applied to the other types of crude oil and environments. This report describes the equipment and process followed for the demonstration and includes recommendations for further efforts needed to develop a fieldable system for use in subsequent testing. This system would need to function at depths of up to 100 feet, in currents of up to 0.5 knots, and perform at least five (5) samples per hour during a 12-hour operating window without bringing a sample to the surface. These performance criteria are based on the experiences during the Deepwater Horizon and Kalamazoo River Spills.</p>		

<b>Response to Oil Sands Products Assessment</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA629936	2015-09-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Hansen, Kurt, Sprague, Mike, Joeckel, John, Rockley, Mark	
<b>Corporate Author:</b>	Coast Guard, New London CT, Research and Development Center	
<b>Descriptors:</b>	bitumens, crude oil, oil products, diluents, dilution, domestic, oil spills, tank cars, pipelines, production, refineries, response, risk analysis, safety, sand, United States	
<b>Identifiers:</b>	oil sands, tar sands, pipeline safety, rail safety, health risks, environmental risks	
<p>Domestic production of crude oil in North America has increased at a tremendous rate. Oil sands products (OSP), such as diluted bitumen (Dilbit) from Alberta, Canada, are subject to spilling during transport to domestic markets and refineries in the U.S. via pipeline, tank cars, or marine vessels. This report includes a qualitative risk assessment of potential spills of Dilbit and identifies initial response issues. Specifically, the following information, along with appropriate recommendations, are documented in this report: Geographic areas most at risk for spills and the prime routes of transportation in those areas. Techniques identified for response to surface oil and submerged oil spills that can address OSPs. Identification of what additional information the U.S. Coast Guard decision-makers need and what additional equipment or tactics responders need to prepare for Dilbit spills in waterways. How addressing these recommendations will provide more robust and safer response to future spills of Dilbit. A description of proposed tasks for future research efforts related to the recommendations.</p>		

<b>Development of Bottom Oil Recovery Systems</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA587502	2014-02-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Girton, Timothy R., Fitzpatrick, Michele, Tebeau, Peter A., Hansen, Kurt A.	
<b>Corporate Author:</b>	Coast Guard, New London, CT Research and Development Center	
<b>Descriptors:</b>	Oil spills, oils, Coast Guard, contracts, detection, environment, forward areas, guidance, lasers, multiple beams(radiation), pollution abatement, prototypes, recovery, sonar, subsurface, test and evaluation, underwater, United States Government, water pollution	
<b>Identifiers:</b>	heavy oil, submerged oil, sinking oil detection	
<p>Facilities or vessels which store or transport heavy and/or sinking oils in U.S. waters must identify response organizations and strategies for responding to spills of these products, including identifying methods for assessing, containing, recovering oil and decanting oil and water from subsurface environments. The U.S. Coast Guard (USCG) has acknowledged current technologies are not adequate to accomplish these objectives. The objective of this project was to develop and test viable designs for systems which can detect and recover oil from subsurface environments. The USCG Research and Development Center (RDC) first addressed detection issues and determined that laser fluorometry and multi-beam sonar were the best practice. RDC then developed specifications and awarded three contracts to design a complete detection and recovery system to Alion Science &amp; Technology</p>		

Corporation, Marine Pollution Control, and the Oil Stop Division of American Pollution Control. In 2011, these three companies were awarded options to build prototypes for testing. This report describes the designs of the three systems and results from prototype testing at the Ohmsett test facility in Leonardo, New Jersey. It also discusses the path forward for submerged oil detection, recovery, and decanting. In Section B, this report provides guidance for Federal On Scene Coordinators (FOSC) on the unique issues that need to be addressed before attempting detection and recovery of any oil sitting on the bottom. Based on this project, guidance is provided for assessment of the environment, selection of recovery techniques and decanting and a list of case histories.

## IT & Networks (ITNET)

### Project# 2021-08 Operational Mobile Technology Architecture

<b>Boarding Team Networking on the Move: Applying Unattended Relay</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA621045	2014-09-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Aras, Ercan	
<b>Corporate Author:</b>	Naval Post Graduate School, Monterey CA	
<b>Descriptors:</b>	communications networks, interdiction, international trade, legislation, organizations, situational awareness, terrorism, theses, tracking	
<b>Identifiers:</b>	maritime interdiction operations, boarding team networking, unattended relay nodes, wireless mesh networks onboard ships, mobile ad hoc networks onboard ships	
<p>As gaps in maritime legislative domain enlarge, threats to our maritime-based global economy are on the rise. Terrorist organizations can leverage every loose policy to use international waters for transferring (weapons of mass destruction) WMDs or to sabotage global trade in choke-points. To prevent any threat posed by terrorist organizations, the enhancement of situational awareness in a maritime domain is crucial for international organizations and states. To prevent any threat in the outer-most perimeters, Maritime Interdiction Operations (MIO) are conducted to enhance situational awareness. Visit Board Search and Seizure (VBSS) constitutes a huge portion of the MIO. Instant communication between the MIO assets and reach-back operations centers plays a critical role both for decision makers to make the best immediate judgments, and for boarding team members to conduct boarding safely. Although networks can be extended to the vicinity of a target vessel, or even onboard, the steel structures of naval vessels obstruct signals to propagate below the main deck. Extending the network below the main deck via a wireless ad-hoc network will enhance the situational awareness. Regarding the boarding of a non-compliant vessel, tracking positions of boarding team members and sustaining reliable and scalable communication links are essential in preventing hostile actions and enhancing reaction time.</p>		

<b>Analysis, Design and Implementation of a Networking Proof-of-Concept Prototype to Support Maritime Visit, Board, Search and Seizure Teams</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA607958	2014-03-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Stewart, Van E.	

<b>Corporate Author:</b>	Naval Post Graduate School, Monterey CA
<b>Descriptors:</b>	Coast Guard operations, security, communication and radio systems, cutters, defense systems, females, law enforcement, males, Marine Transportation, ocean environments, searching, systems management, teams (personnel), United States
<b>Identifiers:</b>	Not Available
<p>The United States Coast Guard (USCG) is composed of 42,000 men and women, spread over nine districts and 35 different sectors, who are tasked with the security and stewardship of our nation's waters. The Coast Guard operates 244 cutters, 1776 small boats and 198 aircraft to meet the needs of its mission. The men and women operating these platforms are tasked with a variety of different mission sets that include maritime security operations, law enforcement, prevention, response, defense operations and marine transportation system management. In 2012, the USCG conducted over 1,700 security boarding on high interest vessels that were bound for the United States. One of the most crucial factors for success during these high-risk evolutions is communications between the host USCG cutter and the men and women who comprise the boarding team.</p>	

<b>Ad-Hoc Sensor Networks for Maritime Interdiction Operations and Regional Security</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA567165	2012-09-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Kontogiannis, Theofanis	
<b>Corporate Author:</b>	Naval Post Graduate School, Monterey CA	
<b>Descriptors:</b>	information exchange, interdiction, joint military activities, law enforcement, multisensors, Naval operations, wireless computer networks, buoys, divers, drones, field tests, ground stations, improvised explosive devices, Naval vessels, nodes, patrol craft, radioactive materials, radiological warfare agents, swimmers, theses	
<b>Identifiers:</b>	Maritime Interdiction Operations, wireless sensor networks, ad hoc sensor networks, regional security, MANET(mobile ad hoc networks), WMN(wireless mesh networks), WSN(wireless ad hoc sensor networks), UAV(unmanned aerial vehicles), boarding teams, USV(unmanned surface vessels), CENETIX(center for network innovation and experimentation), San Francisco Bay, San Francisco police department, Port Authority of New York and New Jersey, James River(Virginia), Souda Bay(Greece), NMIOTC(NATO'S Maritime Interdiction Operational Training Centre)	
<p>Robust communications are key to the success of naval operations such as area surveillance, control, and interdiction. Communications and sensor networks allow the flow of data and critical information that are necessary for conducting such operations from both tactical and strategic perspectives. In naval operations, platforms are hardly stationary, as the networking infrastructure operates from a variety of platforms in motion on the sea, above the sea, and from space. Sensor networks consist of nodes made up of small sensors that are able to monitor, process, and analyze phenomena over geographical regions of varying size and for significant periods. Some categories of these small sensors are able to collect and transmit sensor data about physical values (e.g., temperature, humidity, and sea state), or dynamic attributes of objects, such as speed, direction, and the existence of dangerous substances (e.g., radioactive materials and explosives). The objective of this thesis is to</p>		

examine how unstructured sensor networks, known as ad-hoc sensor networks, can effectively support maritime interdiction operations and regional security by providing reliable communications and flow of information

<b>Identifying Capabilities Gaps in Shipboard Visit, Board, Search, Seizure (VBSS) Teams</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA536605	2010-12-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Ray, Kevin M.	
<b>Corporate Author:</b>	Naval Post Graduate School Monterey, CA	
<b>Descriptors:</b>	manpower, Naval Training, skills, Naval Personnel, interception, TEAMS (personnel), ship personnel, missions, shipboard, Naval Operations, jobs, requirements, theses	
<b>Identifiers:</b>	Not Available	
<p>During the past decade, a primary mission for the United States Navy has become Maritime Interception Operations. Many of these operations involve shipboard Visit, Board, Search, Seizure teams. These imbedded teams consist of motivated sailors who go through a specific training pipeline to become a qualified team member. Once these sailors complete their training pipeline, they return to their command and to their normal job. Visit, Board, Search, Seizure becomes a collateral duty that is often neglected until needed. The author conducted a focus group and administered a survey to individuals with Visit, Board, Search, Seizure experience to determine where the current capability gaps lie. The research found that Visit, Board, Search, Seizure teams are well trained, but shipboard manning requirements and Visit, Board, Search, Seizure as a collateral duty inhibit the team's ability to maintain proficiency.</p>		

<b>Implementation of Software Programmable Radios to Form Ad-Hoc Meshed Networks to Enhance Maritime Interception Operations</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA531534	2010-09-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Vann, Christopher A.	
<b>Corporate Author:</b>	Naval Postgraduate School, Monterey CA	
<b>Descriptors:</b>	radio equipment, communications networks, security, radio links, Naval Operations, interception, information exchange, theses	
<b>Identifiers:</b>	MIO (Maritime Interception Operations), AD HOC, wireless networks, software programmable radios, MIMO (multiple input multiple output), ultra wideband, VBSS(Visit Board Search And Seizure), MESH Networks	
<p>Maritime Interception Operations have become a core competency for United States naval vessels working in conjunction with coalition units in remote waters. An increased need for real-time communication networks exists that will bring VBSS and SOC Teams in contact with experts who can determine the urgency and threat levels of vessels at sea and possible targets on land. The ultimate objective is to deliver timely intelligence, surveillance, and reconnaissance necessary to achieve situational awareness by tactical and strategic decision makers throughout the chain of command. The most critical aspect of this objective is to be able to provide seamless wireless coverage for</p>		

littoral assets and to provide the security of data for sensitive information exchanged between multinational and coalition partners. The objective of this thesis is to evaluate and compare the suitability of ad-hoc wireless networks using software programmable radios in a maritime environment for employment in military and civilian security operations.

Project#2021-03 High Latitude Underway Connectivity

<b>HF Digital Radio Mondiale (DRM) Broadcast Summary Report</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1061702	2018-04-30	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Gonin, Irene M., Dahlen, Aaron P., Shafeian, Hessamoddin, Johnson, Gregory W., Grayson, Christopher	
<b>Corporate Author:</b>	Coast Guard, New London, CT	
<b>Descriptors:</b>	radio communications, digital communications, High Frequency, Arctic Ocean, situational awareness, FIELD TESTS, marine navigation, coast guard	
<b>Identifiers:</b>	DRM(Digital Radio Mondiale), NSI(Navigation Safety Information), NAVTEX, NAVDAT, ANSIS(Arctic Navigational Safety Information System), MSI(Maritime Safety Information), eMSI(electronic Marine Safety Information)	
<p>Digital Radio Mondiale (DRM) is a broadcasting technology that has the potential to disseminate electronic Maritime Safety Information over a wide geographical area. In this report, the Coast Guard Research and Development Center (RDC) presents a Concept of Operations (CONOPS) describing how a single DRM transmitter can provide coverage for the Arctic. The report outlines the methodology upon which the CONOPS is based including an Arctic field test conducted by the RDC in which user feedback and field test data were collected. The test proves that the HF DRM prototype offers an affordable and reliable alternative to distribute navigation safety information. Since the prototype infrastructure is comprised of the existing Coast Guard assets (e.g. USCG HF Transmitters and HF antennas) and proven Commercial-Off-The-Shelf products (e.g. DRM content server, modulator and receiver), the total cost of the prototype is relatively low. In addition, the report investigates how the coverage may be expanded to the contiguous United States and Hawaii. It concludes with specific recommendations for future work required to transition the technology to a public service to the mariner.</p>		

<b>Multipurpose Acoustic Networks in the Integrated Arctic Ocean Observing System</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1013340	2016-09-19	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Mikhalevsky, Peter N., Sagen,Hanne, Worcester, Peter F., Baggeroer, Arthur B., Orcutt,John, Moore, Sue E., Lee, Craig M., Vigness-Raposa, Kathleen J., Freitag, Lee, Arrott,Matthew, Atakan,Kuvvet, Beszczynska-Miller,Agnieszka, Duda, Timothy F., Dushaw, Brian D., Gascard,Jean Claude, Gavrilov, Alexander N., Keers,Henk, Morozov,Andrey K., Munk, Walter H., Rixen, Michel, Sandven,Stein, Skarsoulis,Emmanuel, Stafford, Kathleen M., Vernon, Frank, Yuen, Mo Yan	
<b>Corporate Author:</b>	Leidos, Inc., Arlington United States	

<b>Descriptors:</b>	reprints, acoustic measurement, acoustic waves, acoustic navigation, autonomous vehicles, high resolution, marine transportation, acoustics, passive systems, multipurpose
<b>Identifiers:</b>	active acoustics, cabled networks, acoustic tomography, arctic acoustics, arctic observing system
<p>The dramatic reduction of sea ice in the Arctic Ocean will increase human activities in the coming years. This activity will be driven by increased demand for energy and the marine resources of an Arctic Ocean accessible to ships. Oil and gas exploration, fisheries, mineral extraction, marine transportation, research and development, tourism, and search and rescue will increase the pressure on the vulnerable Arctic environment. Technologies that allow synoptic in situ observations year-round are needed to monitor and forecast changes in the Arctic atmosphere-ice-ocean system at daily, seasonal, annual, and decadal scales. These data can inform and enable both sustainable development and enforcement of international Arctic agreements and treaties, while protecting this critical environment. In this paper, we discuss multipurpose acoustic networks, including subsea cable components, in the Arctic. These networks provide communication, power, underwater and under-ice navigation, passive monitoring of ambient sound (ice, seismic, biologic, and anthropogenic), and acoustic remote sensing (tomography and thermometry), supporting and complementing data collection from platforms, moorings, and vehicles. We support the development and implementation of regional to basin-wide acoustic networks as an integral component of a multidisciplinary in situ Arctic Ocean observatory.</p>	

<b>Maritime Geo-Fence Letter Report</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1023798	2016-07-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Gonin, Irene, Johnson, Gregory	
<b>Corporate Author:</b>	United States Coast Guard, New London	
<b>Descriptors:</b>	automatic identification systems, software development, transmitting, biometric security, dead reckoning, safety, ships, global positioning systems, navigational aids, identification systems, coast guard, information retrieval, Alaska, message processing, Very High Frequency	
<b>Identifiers:</b>	EMSI (electronic Maritime Safety Information), mariners, GEO FENCING	
<p>The United States Coast Guard (USCG) Research and Development Center (RDC) in partnership with the Marine Exchange of Alaska (MXAK) have been exploring the feasibility of various means of transmitting electronic Maritime Safety Information (eMSI) to mariners in the Alaskan area. The communications path evaluated is the Very High Frequency (VHF)-based Automatic Identification System (AIS). For the Arctic Technology Evaluation 2015 (ATE-15), the RDC utilized the CG Cutter HEALY (polar ice breaker) to conduct testing of various AIS Transmit features to determine their utility for improving CG marine safety and security capabilities in the Arctic. During ATE-15 three different operations were tested using AIS Technology.</p>		

<b>Thin-Ice Arctic Acoustic Window (THAAW)</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA618125	2014-09-30	Distribution Statement A. Approved for public release. Distribution is unlimited.

<b>Author:</b>	Worcester, Peter F., Cornuelle, Bruce D., Dzieciuch, Matthew A., Munk, Walter H.
<b>Corporate Author:</b>	SCRIPPS Institution of Oceanography, LA Jolla CA
<b>Descriptors:</b>	acoustic windows, ambient noise, Arctic Ocean, ICE, low frequency, open water, signal processing
<b>Identifiers:</b>	THAAW (Thin Ice Arctic Acoustic Window)
<p>The Arctic Ocean is currently undergoing dramatic changes, including reductions in the extent and thickness of the ice cover and extensive warming of the intermediate layers. The multiyear ice is melting. Ice keels are getting smaller. With more open water, the internal wave energy level and therefore acoustic volume scattering are likely increasing, at least during summer. What was learned about acoustic propagation and ambient noise in the Arctic during the Cold War is now obsolete. The long-term objectives of this research program are to understand the effects of changing Arctic conditions on low-frequency, deep-water propagation and on the low-frequency ambient noise field. The goal is to determine the fundamental limits to signal processing in the Arctic imposed by ocean and ice processes. The hope is that these first few new steps will lead to a larger, permanent acoustic monitoring, communications, and navigation network in the Arctic Ocean (Mikhalevsky et al., 2014). This research effort was funded as an expansion of ONR Grant N00014-12-1-0226, entitled North Pacific Acoustic Laboratory: Deep Water Acoustic Propagation in the Philippine Sea. This annual report is in addition to the annual report for ONR Grant N00014-12-1-0226 that describes the research effort in the Philippine Sea.</p>	

## Modeling, Simulation and Analysis (MSA)

Project# 2021-15 Applications of Robotic Process Automation

<b>Rapid Assemblers for Voxel-Based VLSI Robotics</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA624431	2014-02-12	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Lipson, Hod, Hillar, Jonathan, Perich, Cheryl, Bernard, Steve, MacCurdy, Rob, Apoorva, Fnu	
<b>Corporate Author:</b>	Cornell University, Ithaca NY	
<b>Descriptors:</b>	robots, very large scale integration, alignment, assemblers, computer aided manufacturing, electronic equipment, electrophoresis, fabrication, graphical user interface, lattice dynamics, modular construction, parallel processing, scaling factor, self-operation, simulators, software tools, systems engineering, wetting	
<b>Identifiers:</b>	digital manufacturing, 3D printing, rapid assembler, electro-wetting, electro-adhesion, VOXCAD, LEGO Electronics, CUDA Based Physics Simulator, PE0620BK	
<p>The goal of this research is to develop scalable fabrication methods and design tools for assembling large scale robots out of billions of micro scale building blocks (voxels) arranged on a regular 3D lattice. Traditionally, robotic systems are constructed of custom-designed and fabricated components with arbitrary geometric and functional interfaces. The arbitrary nature of such integrations makes it difficult to design, simulate and fabricate complex 3D machines, as well as to repair, adapt and recycle existing machines, and to perform rigorous design automation. In contrast, electronic systems have reached very large scale integration (VLSI) levels through consistent definition of elementary building</p>		

blocks, interfaces, and design rules. Biological systems, too, construct, repair, adapt and recycle large scale and complex 3D organisms by combining and recombining a relatively small repertoire of building blocks types - cell types, proteins types or amino acids types, depending on the scale of interest. In this proposal we envision a new robotics paradigm where machines are comprised of very large scale integration of billions of small scale building blocks (voxels). If each voxel has the size of about 300 microns, then the resulting assembly could look as smooth to the eye as a typical XGA LCD display - at about 85 Pixels Per Inch (PPI). The voxels will be self-aligning and interlocking, resulting in integrated and precise large scale integrations. Some voxels can be passive and very cheap, while others might be active sensors, actuators, computational and power components used more sparingly. The range of types of voxels available will define the range machines that can be fabricated.

<b>RTMBA: A Real Time Model Based Reinforcement Learning Architecture for Robot Control</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1024565	2012-05-18	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Hester, Todd, Stone, Peter	
<b>Corporate Author:</b>	University of Texas at Austin, Austin TX	
<b>Descriptors:</b>	algorithms, real time, learning, robots, decision making, robotics, Artificial Intelligence, problem solving, training	
<b>Identifiers:</b>	reinforcement learning	
<p>Reinforcement Learning (RL) is a paradigm for learning decision-making tasks that could enable robots to learn and adapt to their situation on-line. For an RL algorithm to be practical for robotic control tasks, it must learn in very few samples, while continually taking actions in real-time. Existing model-based RL methods learn in relatively few samples, but typically take too much time between each action for practical on-line learning. In this paper, we present a novel parallel architecture for model-based RL that runs in real-time by 1) taking advantage of sample-based approximate planning methods and 2) parallelizing the acting, model learning, and planning processes in a novel way such that the acting process is sufficiently fast for typical robot control cycles. We demonstrate that algorithms using this architecture perform nearly as well as methods using the typical sequential architecture when both are given unlimited time, and greatly out-perform these methods on tasks that require real-time actions such as controlling an autonomous vehicle.</p>		

<b>Magician Simulator: A Realistic Simulator for Heterogenous Teams of Autonomous Robots. MAGIC 2010 Challenge</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA536485	2011-02-07	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Powers, David M., Atyabi, Adham, Anderson, Tom A., Treharne, Kenneth	
<b>Corporate Author:</b>	Flinders University of South, Adelaide AU	
<b>Descriptors:</b>	simulators, autonomous navigation, unmanned, robots, cooperation, autonomic agents, reconnaissance, surveillance, multi-agent systems, control, vehicles	
<b>Identifiers:</b>	cooperative control, unmanned vehicles, autonomous agents and multi agent systems	

The Multi-Autonomous Ground-robotic International Challenge (MAGIC) is an intelligent surveillance and reconnaissance mission in a dynamic urban environment aimed at developing autonomous multi-robot systems. The Australian MAGICian team have assembled a multidisciplinary team from a number of leading industry and research institutes to enter the MAGIC challenge. Our approach leverages our team's skills in Artificial Intelligence, Robotics Computer Vision, Signal Processing, Autonomous Agents and Multi-Agent Systems, Human Computer Interfaces and Systems Engineering in order to deliver a well-engineered autonomous solution.

<b>SCAMP Anti-Personnel Mine Roller Performance Testing</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA550122	2011-01-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	de Brun, Erik, Poff, Scott	
<b>Corporate Author:</b>	Ripple Design LLC Philadelphia PA	
<b>Descriptors:</b>	antipersonnel mines, automation, mine clearance, minesweeping equipment, performance (engineering), robotics, rollers, army equipment, gravel, humanitarian assistance, Michigan, operational effectiveness, reprints, robots, silt, soil compaction, Sweden	
<b>Identifiers:</b>	SCAMP(Specialized Compact Automated Mechanical Clearance Platform Roller), SCAMP Roller Testing, mine rollers, mechanical demining equipment, topsoil, silt gravel mixture, road gravel, Chinese 72a Mine, Russian PMN 1 Mine, Russian PMN 2 Mine, test mines	
<p>Humanistic Robotics Inc., a U.S.-based designer and manufacturer of mechanical demining machines and robotic-support equipment, hypothesized that a well-designed roller utilized in the appropriate environments would be an important part of the mechanical demining toolkit. To test this hypothesis, HRI designed, developed, and tested a novel anti-personnel mine roller -- the Specialized Compact Automated Mechanical Clearance Platform Roller. As part of the development process, HRI studied existing mine rollers and researched the key characteristics governing mine-roller effectiveness. To properly evaluate the SCAMP Roller's clearance performance, a series of formal tests were conducted at the Keweenaw Research Center in Houghton, Michigan (U.S.) and the Swedish EOD and Demining Centre (SWEDEC) near Eksjo, Sweden. The key parameters evaluated were mine type, soil conditions, compaction level above and around the mine, and roller speed. This article highlights the SCAMP Roller's unique design features, describes the two testing events performed to evaluate its effectiveness, and discusses the test findings.</p>		

<b>A robotic module for stochastic fluidic assembly of 3D self-reconfiguring structures</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
ADA578827	2010-0501	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Neubert, Jonas, Cantwell, Abraham P., Constantin, Stephane, Kalontarov, Michael, Erickson, David, Lipson, Hod	
<b>Corporate Author:</b>	Cornell University Office of Sponsored Programs, Ithaca NY	

<b>Descriptors:</b>	Assembly, configurations, robots, stochastic processes, alloys, chambers, disassembly, environments, flow, fluidics, fluids, robotics, scaling factor, symposia
<b>Identifiers:</b>	Not available
<p>Stochastic self-reconfiguring robots are modular robots that possess the ability to autonomously change the arrangement of their modules and do so through the use of nondeterministic processes. We present a concept for a robotic system in which the stochastic behavior of turbulent flow in a chamber is used during assembly and disassembly operations. The thermorheological properties of Pluronic (registered) are used to implement flow routing for controlling the assembly process. This is the first use of thermorheological valving in three dimensions. A novel reversible module connection mechanism using a low melting point alloy which is soldered in a fluid environment is presented. Together with our approach to self-alignment, these are the innovations required to allow scalable self-directed assembly in three dimensions.</p>	

## Surface

### Project# 2021-11 Cold Spray Restoration of Vessel and Aircraft Components

<b>Cold Sprayed Coatings with Dual Nanoparticle Reinforcements for Wear and Corrosion Protection</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1114683	2020-06-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Norrell, Travis	
<b>Corporate Author:</b>	Naval Postgraduate School, Monterey CA	
<b>Descriptors:</b>	additive manufacturing, nanoparticles, ceramic matrix composites, metal matrix composites, surface properties, heat energy, mechanical properties, composite materials, ceramic materials, material degradation processes, wear resistance, materials processing, thermal spraying	
<b>Identifiers:</b>	Cold spray, dual, reinforcement	
	<p>As a form of additive manufacturing, the use of cold spray has made significant strides since different-sized particles were explored in the process. There is proof that micron-sized particles down to nanoparticles enhance the mechanical material properties of a substrate in wear resistance. Micron- and submicron-sized particles are beneficial, but due to their low relative surface areas, they tend to exhibit pull out more often and do not adhere to a substrate as well as a nanoparticle. Using nanoparticle metal and dual ceramic matrix reinforcements, six composites were fabricated through cryomilling and then applied to an aluminum substrate as a cold sprayed coating. Using nano-boron carbide (nB4C) and boron nitride nanoplatelets (BNNP) at various combinations up to 2 vol percent, an increase of 11.59 percent in hardness from the control was achieved. Wear testing of each coating was performed, but most of the tests drove through the coatings into</p>	

	the substrate, indicating more refinement of the testing parameters is required. Additionally, corrosion testing was performed on cold sprayed samples for 500- and 2,000-hr trials in a salt fog chamber, revealing underlying pitting corrosion and galvanic corrosion vulnerabilities of the coatings. In the right application, the U.S. Navy could potentially use these coating materials in parts that are subjected to austere marine environments.
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<b>Cold Spray Coatings for Chromium and Nickel Plating Replacement</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1092344	2019-11-05	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Nardi, Aaron	
<b>Corporate Author:</b>	US Army Research Laboratory, East Granby	
<b>Descriptors:</b>	computational fluid dynamics, chemical synthesis, volatile organic compounds, thermal spraying, numerical analysis, galvanic corrosion, coatings	
<b>Identifiers:</b>	Cold spray, wear, WC Co, WC CoNi, Cr3C2 Ni	
<p>The objective of this project was to develop cold spray coating as an environmentally benign process to replace hard chromium and nickel electroplating used for localized repair of weapons system components. The approach that the Cold Spray Team has taken was not just to develop a specific coating or set of coatings to replace Cr and Ni electroplates, but also to develop and deploy a holistic approach to cold spray development that would employ all the modern computational and analytical tools at our disposal to develop and optimize the powders, spray equipment, and deposition conditions to bring cold spray coating technology to production rapidly and reliably.</p>		

<b>Development of Stress Balancing Cold Spray Deposition for Flatness Evaluation</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1073778	2019-05-21	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Ferguson, Gehn, Nault, Isaa	
<b>Corporate Author:</b>	US Army Combat Capabilities Development Command, Army Research Laboratory Aberdeen Proving Ground, MD	
<b>Descriptors:</b>	deposition (materials processing), residual stress, electromagnetic interferences , powder metals, motion planning, thickness, tantalum, METAL coatings, distortion, shielding, substrates, robotics, repair	
<b>Identifiers:</b>	cold spray deposition, gas dynamic cold spray, metal powder, repair technology, advanced path planning, flatness, EMI (electromagnetic interference, EMI shielding, compressive residual stresses, Stress Balancing	
<p>Tantalum (Ta) coatings are desired for electromagnetic interference shielding on thin components. Cold spray is an effective means of depositing Ta, but residual compressive stresses can distort thin components out of tight flatness tolerances. The effect of cold spray process parameters on compressive residual stress are studied with the objective of minimizing residual stress and component distortion. In this report, a technique for applying cold spray coatings to balance compressive residual</p>		

stresses is demonstrated. In a successful demonstration of this technique, a flatness of 0.005 inches was achieved across an 8- 4-inch panel with a total Ta coating thickness of 0.030 inches.

<b>Stochastic Models for Cold Sprayed Microstructures</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD10582326	2018-07-31	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Willot,Francois, Bortolussi,Vincent, Jeandin,Michel, Figliuzzi,Bruno, Faessel,M atthieu	
<b>Corporate Author:</b>	Centre for Mathematical Morphology, Fontainebleau FR	
<b>Descriptors:</b>	microstructures, Stochastic Processes, geometry, carbon fiber reinforced polymer, polymer matrix composites, materials science, thermal spraying	
<b>Identifiers:</b>	cold spray, models of random structures, stochastic geometry, stereology	
<p>(U) We study the microstructure of cold sprayed films of copper particles deposited onto a carbon fiber reinforced polymer. The microstructure of the coating is made of a packing of seemingly round-shaped particles of varying sizes embedded in a polymer matrix. The copper particles are separated by thin interstices. The coating is designed to cover the body of recent commercial aircrafts. Its role is to protect the aircraft from lightning impact by ensuring that the surface is conductive enough to evacuate electrical charges. A high resistivity contrast is observed between the copper particles and the polymer matrix. Therefore, the global resistivity of the material is highly dependent on the microstructure geometry. Following an approach commonly used in materials science, to investigate its influence on the electrical properties of the global material at the macroscopic scale, we design a 3D multiscale stochastic model that enables us to simulate the microstructure. The model is based upon a generalization of the classical Johnson-Mehl tessellation, which accounts for the interstices that appear between copper particles. The method is very general and could potentially be applied to model any microstructure exhibiting similar interstices between aggregates of particles.</p>		

Project# 2021-16 Enhanced Rotary Wing Night Vision Goggle (NVG) Searches  
**There were no Distribution A technical reports were found for this topic area within the date range specified.**

Project# 62103 - Polar Regions Technology Evaluation 2021-2022

<b>U.S. Strategic Interests in the Arctic: A Proposed Department of Defense Approach</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1118724	2019-10-29	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Chess, Timothy W.	
<b>Corporate Author:</b>	Marine Corps University Press, Quantico VA	
<b>Descriptors:</b>	cold war, foreign relations military exercises, New York, Arctic Regions, Europe, infrastructure, security, training, United States Special Operations Command, Department of Defense, Military training, North America, warfare, Air Force, Unified Combatant Commands, United States, European Command, United States Northern Command, National Security	

<b>Identifiers:</b>	Arctic, Department of Defense, DOD, Russia, China, North Atlantic Treaty Organization, NATO, cooperation, Unified Command Plan, U S European Command
<p>In the wake of climate change, the Arctic is witnessing a level of transportation and access to resources unprecedented in modern history. Since the end of the Cold War, the Arctic has been a region of cooperation among both Arctic and non-Arctic nations. However, as the region witnesses an increased level of activity and race for resources, so too will the level of stress increase the strain on cooperation and diplomatic relationships, especially those between Russia and the West. The United States has been slowly preparing for an increased presence in the Arctic region, publishing its first strategic security document earlier this decade. The progress of the Department of Defense (DOD) still pales in comparison to current competitors efforts in the Arctic. To protect national interests in the Arctic, the DOD requires a new plan of action focused on increased levels of cooperation, force, equipment, and infrastructure improvements, as well as revising the departments Unified Command Plan. This plan should provide a strategic message to allies, partners, and adversaries alike that the United States is prepared to operate in the Arctic.</p>	

<b>Polar Ocean Observations: A Critical Gap in the Observing System and its Effect on Environmental Predictions from Hours to a Season</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1099658	2019-08-06	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Hebert ,David, Metzger ,E. J., Allard ,Richard, Smith, Gregory C., Babin, Marcel, Bertino, Laurent, Chevallier, Matthieu, Corlett,Gary, Crout, Julia, Davidson, Fraser, Delille, Bruno, Gille, Sarah T., Hyder, Patrick, Intriери, Janet, Lagunas ,Jose, Larnicol, Gilles, Kaminski, Thomas, Kater, Belinda, Kauker, Frank, Marec, Claudie	
<b>Corporate Author:</b>	Naval Research Lab Washington DC	
<b>Descriptors:</b>	accuracy, databases, detectors, ocean observing systems, physics laboratories, sea surface temperature, boundary layer, oceans, remote sensing, surface properties, surface temperature, united states, detection, weather forecasting, ocean currents, sea water, measurement, geography, topography, oceanography	
<b>Identifiers:</b>	Not available	
<p>There is a growing need for operational oceanographic predictions in both the Arctic and Antarctic polar regions. In the former, this is driven by a declining ice cover accompanied by an increase in maritime traffic and exploitation of marine resources. Oceanographic predictions in the Antarctic are also important, both to support Antarctic operations and also to help elucidate processes governing sea ice and ice shelf stability. However, a significant gap exists in the ocean observing system in polar regions, compared to most areas of the global ocean, hindering the reliability of ocean and sea ice forecasts. This gap can also be seen from the spread in ocean and sea ice reanalysis for polar regions which provide an estimate of their uncertainty. The reduced reliability of polar predictions may affect the quality of various applications including search and rescue, coupling with numerical weather and seasonal predictions, historical reconstructions (reanalysis), aquaculture and environmental management including environmental emergency response. Here, we outline the status of existing near-real time ocean observational efforts in polar regions, discuss gaps, and explore perspectives for the future. Specific recommendations include a renewed call for open access to data, especially real-</p>		

time data, as a critical capability for improved sea ice and weather forecasting and other environmental prediction needs.

<b>Geomagnetic Energy Distribution and Influence on the Ionosphere/Thermosphere in the Polar Region</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1085633	2019-02-13	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	Deng, Yue	
<b>Corporate Author:</b>	University of Texas at Arlington, TX	
<b>Descriptors:</b>	ionosphere, Polar Cap, Thermosphere, magnetosphere, electric fields, magnetic storms	
<b>Identifiers:</b>	Poynting Flux, Geomagnetic energy distribution, Pedersen conductance, particle precipitation, nitric oxide cooling	
<p>The objective of the project is to improve the specification of the magnetospheric energy inputs, including both Poynting flux and particle precipitation, in the polar upper atmosphere and to determine how the ionosphere and thermosphere respond to the geomagnetic energy distribution in order to improve the predictability of this response and effects on satellite drag and high frequency (HF) wave propagation paths. We made great progresses in the following directions: 1. Based on the Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) satellites observations of electron density profiles from 2009-2014, Pedersen conductivity has been estimated. A climatologic study of the height-integrated Pedersen conductances in both E (100150 km) and F (150600 km) regions and their ratio in different seasons, solar and geomagnetic conditions has been conducted. 2. To understand the significance of different physical mechanisms including Poynting flux and particle precipitation, and the correlation between them, a statistical study of Poynting flux and particle energy flux in the dayside cusp and low-latitude boundary layer (LLBL) regions has been conducted based on DMSP F15 measurements. 3. The electric field and the particle precipitation at different spatial scale sizes have been investigated by utilizing the Dynamic Explorer 2 satellite data set, focusing on conditions of moderately strong southward interplanetary magnetic field. 4. The influence of an idealized, smaller Carrington-type storm on the thermosphere in the high latitudes has been simulated using the nonhydrostatic Global Ionosphere-Thermosphere Model. 5. The energetic electrons and ions (0.130.2 keV) measured by DMSP are binned according to geomagnetic coordinates.</p>		

<b>Tidal Energy Resource Assessment for McMurdo Station, Antarctica</b>		
<b>Accession Number:</b>	<b>Report Date:</b>	<b>Access Restrictions:</b>
AD1025148	2016-12-01	Distribution Statement A. Approved for public release. Distribution is unlimited.
<b>Author:</b>	West, Brendan A., Gagnon, Ian F., Wosnik, Martin	
<b>Corporate Author:</b>	Engineer Research And Development Center Hanover NH	
<b>Descriptors:</b>	energy conservation, Polar Regions, Antarctica, Renewable energy, Ocean Tides, energy production, tidal turbines, energy conversion, Bathymetry, climate, meteorological data, observation, ecology, electrical grids, velocity, ocean currents, regulations	

<b>Identifiers:</b>	energy conservation analysis, EPOLAR (Engineering for Polar Operations Logistics and Research), McMurdo Station (Antarctica), NSF (national science foundation), Ocean energy resources, Renewable energy sources, Tidal energy resource assessment, Tidal power, McMurdo Sound, USAP (Unites States Antarctic Program), Tidal characteristics, McMurdo sound ecology, environmental effects, current Speeds
<p>The U.S. Antarctic Program (USAP) is interested in expanding renewable energy capabilities at McMurdo Station, Antarctica, to reduce costs and emissions. Previous assessments considered wind, solar, and geothermal energy resources but not ocean energy resources such as tidal energy. The National Science Foundation, Division of Polar Programs, Antarctic Infrastructure and Logistics, commissioned the Cold Regions Research and Engineering Laboratory to assess the feasibility of a tidal energy system in the waters near McMurdo Station. This study used industry standards to assess relevant datasets, including bathymetry, tidal characteristics, meteorological, and icing data. Unfortunately, the available data was insufficient for full annual energy production estimates; however, the data unanimously indicated that current speeds within Winter Quarters Bay and the adjacent McMurdo Sound are much too low for tidal energy generation. The maximum measured current speed was less than the typical cut-in speed for most tidal energy turbines. Additional challenges, including the recent declaration of the Ross Sea as a marine protected area and the need for high-strength infrastructures to withstand icing, make the McMurdo Station region a poor location for a tidal energy installation. USAP would likely fail to recoup the costs associated with such a system. Although tidal energy is not suitable for this case, this report presents a collated set of various tidal-related data for the McMurdo Station region, which may be of use to other studies.</p>	

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