Science & Technology Directorate
Center for Maritime, Island and Remote and Extreme Environment Security (MIREES)
COE S&T Review

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Dr. Julie Pullen and Dr. Margo Edwards
MIREES Co-Directors
Washington, D.C.
## MIREES Overview

### COE Description

- **Mission Statement:** To strengthen maritime domain awareness and safeguard populations and properties unique to U.S. waterways, ports, islands, and remote and extreme environments.

- **Scope:**
  - National Strategy for Maritime Security
  - Maritime Domain Awareness (MDA)
  - Maritime Threat Response
  - Maritime Transportation System (MTS) Security
  - Maritime Commerce Security
  - Global Maritime Intelligence Integration
  - Coordination of Domestic and International Efforts and Outreach

### Co-Leads

- **Stevens Institute of Technology – The Center for Secure and Resilient Maritime Commerce (CSR)**
  - Enhance MDA through the use of sensor technologies to form a layered approach to maritime and port security.
  - Leverage systems engineering tools and techniques to enhance the resilience of ports and the MTS.

- **University of Hawaii – The Center for Island, Maritime and Extreme Environment Security (CIMES)**
  - Research focuses on safety and security of extreme and remote environments.
  - Leverages autonomous systems, coastal radars, acoustics and air/space platforms to enhance situational awareness.

### History and Funding

- **Established in 2008**
- MIREES has received the following funds through OUP vehicles:
  - $24.1M in base financial assistance funding from OUP
  - $3.5M in financial assistance funding from other sources
  - $2.97M in contract funding under the Basic Ordering Agreement
### CSR Research Overview

#### Research Theme Areas
- **Maritime Domain Awareness**
  - Sensor technology development
  - Threat signature characterization
  - Data analysis and integration
  - Real-time information delivery
- **Marine Transportation System and Port Resiliency**
  - Data gathering
  - MTS modeling
  - Scenario-based assessments of risk and vulnerability
  - Decision support methodologies and tools

#### Expected Uses
- Multi-modal MDA sensors used for maritime and port security applications, situational awareness and surveillance capabilities. Achieve real-time, all-weather, day/night, multi-layer, domain-overlapping maritime surveillance from the open ocean to estuaries, harbors and inland waterways (e.g., Acoustics and Electro-optics, HF Radar, Satellite)
- Decision support systems - visualization techniques and real-time environmental, oceanic, and atmospheric information (e.g., Magello, developed by students)
- MTS and port resilience tools to prevent and protect, minimize damage and expedite recovery from attacks or catastrophic events (e.g., Port Mapper)

#### Customers
- U.S. Coast Guard (USCG)
- Customs and Border Protection (CBP)
- National Oceanic and Atmospheric Administration (NOAA)
- U.S. Navy
- U.S. Port Authorities
- Department of Transportation (DOT)
- Federal Emergency Management Agency (FEMA)
- DHS Science and Technology Directorate (DHS S&T)
- Local, state and municipal emergency responders
Project Description

- Goal: Achieve real-time, all-weather, day/night, multi-layer, domain-overlapping maritime surveillance from the open ocean to estuaries, harbors and inland waterways
- Integrated Layers:
  - Satellite-based wide area surveillance
  - High-Frequency (HF) Radar systems providing over-the-horizon surveillance of the approaches
  - Nearshore and harbor surveillance systems centered on underwater acoustic technologies

Impact & Relevance

- Evaluating effectiveness based on end-user usage statistics for applications including SAROPS and vessel detection and tracking
- Vessel tracking and illicit vessel and underwater threat detection, classification and tracking
- USCG MDA technology assets improved by the layered technology
- CBP increased intelligence on localization of possible illicit vessels to optimize the deployment of airborne assets and use in the detection and tracking of aircraft along border
- U.S. Navy use in Integrated Swimmer Defense System

End Users/Partners

Deployed

- Experiments and field tests in the Caribbean, Port of Miami and the New York Harbor

In Development

- USCG – improve search and rescue operations; small vessel detection, characterization, identification, and tracking; decision support system, including hostile intent
- CBP – increase illicit vessel detection; border aircraft detection and tracking
- Navy – real-time multi-static vessel detections delivered to the Navy’s Open Mongoose data fusion engine for MDA; Integrated Swimmer Defense System
- S&T Borders & Maritime Security Division – algorithms for localization and classification
 CSR Education Overview

**Description**
- Central to the CSR’s mission is the transition of its research into relevant maritime security-centric educational programs. Students are integrated into all CSR research projects. Supports DHS by helping to develop highly-skilled students, able to assume technical leadership positions within the maritime and homeland security domain.

**Goals**
- Enhance student knowledge, technical skills, leadership capabilities and interest in maritime security.
- Stakeholder engagement and collaboration.
- HS workforce development

**Collaborations/Partnerships**
- Students engage in research projects and activities in collaboration with the USCG, CBP, U.S. Navy, NUSTL, NJOHSP, PANYNJ, NYPD, DHS S&T
- Experiential Learning:
  - Field-based internships & site visits: CBP, USCG, NUSTL, NYC OEM, FDNY, PANYNJ, U.S. Navy
  - Participate in local, state, & municipal full-scale & table-top emergency response exercises
  - Research presentations at conferences and stakeholder meetings (NSIC, USCG, DHS S&T Summits)
  - Engage in independent research projects with stakeholders

**Workforce Development**
- **Programs Offered:** Professional Development, Graduate Certificate, Master’s, Ph.D.
- **Courses developed:** Advanced Maritime Security
- **Research areas of COE-supported students:** (9)
- **Student fellowships offered:** Master’s Degree and Ph.D. Fellowships
- **Type of COE-supported Students:** Undergraduate, Master’s and Ph.D.

**Professional Development**
- **Practitioner Attendees:** USCG, CBP, NYPD
- **Professional development programs delivered:**
  - Port Security Awareness (1 Day – NYPD)
  - Port Security Sensor Technologies (3 Day course, USCG attendees)
  - USCG Auxiliary – About Boating Safely (1 Day)
  - CSR Seminar Series. Topics include: MDA, MTS, Port Resilience, Maritime Piracy
- **Convenient/Flexible Delivery:** Courses are delivered by CSR researchers and by CSR stakeholders. Courses held online, and on-campus at Stevens in Hoboken, NJ and Washington, DC.
### Description
- 8-week intensive, maritime security focused summer research program for undergraduate and graduate-level engineering and science majors.

### Goals
- Engage students in hands-on, multi-disciplinary research in collaboration with CSR researchers and stakeholders.
- Inspire innovation and novel approaches to complex Homeland Security problems.
- Enhance student professional development and interest in advanced study and careers in Homeland Security.

### Impact & Relevance
- Students apply engineering and science skills toward maritime and Homeland Security applications.
- Students collaborate shoulder-to-shoulder with researchers and stakeholders on real-world HS issues.
- Projects have a direct utility and application to HS practitioners and their operations.
- Students enhance their technical skills and professional capabilities through oral presentations, research reports and networking with stakeholders.
- Students work as part of a multi-disciplinary team.
- The Summer Research Institute has effectively engaged 70 students from around the nation in the program.

### Educational Capabilities & Opportunities
- Programs can be tailored to specific audiences. Programs include Professional Development, Graduate Certificate, Master’s and Doctoral Degrees, and experiential summer research programs.
- Courses are held in convenient, flexible formats (Online and on-campus at Stevens in Hoboken, and in Washington, DC.)
- Courses, workshops and seminars are delivered by CSR researchers in collaboration with stakeholders. (NYPD, CBP, FAS, and NJ OHSP)

### Potential Program Opportunities:
- Customized cohort-based Maritime Security and Maritime Systems Engineering Graduate Certificate programs for USCG and CBP stakeholders. (Four courses, 12 graduate credits. Credits earned can be applied toward a Master’s)
- Courses delivered online and on-campus (Hoboken and Washington, DC)
### CSR Research and Education Successes

<table>
<thead>
<tr>
<th>Accomplishment</th>
<th>Impact/End Users</th>
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</table>
| **Summer Research Institute (SRI) – Delivered consistently over the past four years** | ▪ 70 students from around the nation, representing 16 universities including MSI universities  
▪ More than half of the participants have been women and/or students from underrepresented communities  
▪ Students have generated new knowledge and developed tools in support of CSR stakeholders. (E.g. Magello, portable underwater sound recorder, field-based experiments, case studies, acoustic database, etc.)  
▪ SRI students have been selected to present at the NSIC, USCG Innovation Showcase, DHS S&T Summits, and have been awarded “Best Student Paper” awards |
| **MSI and HBCU faculty and student engagement in the Summer Research Institute and in CSR research activities** | ▪ Students and faculty from Elizabeth City State Univ. (ECSU), Jackson State, John Jay College, Morgan State, Norfolk State, Univ. of Guam, and UPRM, have engaged in the Summer Research Institute.  
▪ ECSU will partner with CSR in its COE re-compete.  
▪ CSR regularly sets aside funding to support MSI/HBCU participation in the SRI.  
▪ CSR has hosted a DHS MSI Summer Research Team from City University in NYC. |
| **Stakeholder Engagement and Outreach** | ▪ CSR holds regular Stakeholder engagement meetings.  
▪ Delivers relevant professional development opportunities to the USCG and workshops and seminars for first responders and emergency response stakeholders.  
▪ Leverage stakeholder relationships to develop and enhance academic curricula.  
▪ Leverage stakeholder relationships for student internships, projects and placement. |
| **Student placement in HS field-based internships and employment** | ▪ Graduates from the DHS CDG Maritime Systems Fellowship and other COE supported students are now employed at: Pacific Northwest National Labs, NATO Centre for Maritime Research and Experimentation, Stevens Institute, and Parsons Brinkerhoff  
▪ Students have engaged in field-based internships with the USCG and the U.S. Navy.  
▪ Students continue to collaborate and engage with stakeholders beyond the Summer Research Institute. |
### Research Theme Areas

- **Maritime Domain Awareness in the Arctic**
  - Autonomous Power Systems for Remote and Hostile Environments
  - Integrated Coastal Radar Observation System
  - Coastal Radars Detection of Vessels
  - Unmanned Aerial Systems
  - Satellite Observation and Integration
  - Arctic Acoustics – Monitoring and Mechanisms
  - Acoustic Monitoring Systems for the Arctic
  - Underwater Acoustic Data Acquisition System (UADAS)
  - Situational Awareness Tools (SAT)

### Expected Uses

- Development and deployment of multi-use technologies for collecting environmental and scientific data that enable predicting, identifying and monitoring potential hazards in near real-time.
- Improved Arctic awareness that enhances the ability of first responders to surge capabilities in time and place to effectively respond to events.
- Development of a common operating picture that leverages existing observing assets and empowers stakeholders in tactical situations

### Customers

- U.S. Coast Guard (USCG)
- Customs and Border Protection (CBP)
- Federal Emergency Management Agency (FEMA)
- National Oceanic and Atmospheric Administration
- U.S. Navy / NORTHCOM
- Bureau of Ocean Energy Management
- National Science Foundation
- Oil and Gas Industry
- Marine Transportation Industry
- Alaska North Slope Borough
- Local, state and municipal emergency responders
CIMES End-to-End – Arctic MDA

Project Description

- **Goal:** Contribute to Arctic MDA by enhancing a Common Operating Picture to facilitate search and rescue, environmental protection, disaster response, and border security operations. The CIMES Arctic E2E aims to address four specific scientific and technology capability gaps by improving:
  - Communications architecture
  - MDA, particularly during shoulder and ice-free seasons
  - Operating and logistical infrastructure
  - Lack of arctic-trained personnel

Impact & Relevance

- Informing USCG with basic research to support Arctic oil spill response and SAR operations
- Developing portable, cost-effective power solutions to expand Arctic communications and infrastructure
- Supporting USCG humanitarian missions (Nome fuel re-supply)
- Developing improved, integrated data products for use by USCG, marine transportation and exploration industries plus local residents to promote safe operations
- Evaluating system and sensor performance in the Arctic
- Supporting USCG Arctic Shield 2013
- Supporting USCG R&D Center Coda Octopus evaluation
- Collaborating with commercial marine-band radar manufacturers to enhance ice detection

End Users/Partners

**Deployed**

- **USCG/BOEM/Oil Industry:** North Slope summer seasons for RPM and sensors (HF radars, AIS)
- **Furuno:** Year-round marine-band radars in Barrow, Alaska to study break-out of shorefast ice
- **USCG/State of Alaska/Oil Industry:** Unmanned aerial systems in multiple missions evaluating ice mapping, oil spill detection, marine mammal protection
- **Maritime Transportation (Canatec):** Satellite data products for improved ice navigation

**In Development**

- **USCG RDC:** Passive and active acoustics above, at and below the ice surface, HF radar evaluation, Arctic COP
CIMES Education Overview

### Description
- CIMES does not currently receive funding from DHS S&T to support educational program development – this objective is accomplished via our sister center CSR. CIMES does include students in all research. CIMES partner UPRM continued an undergraduate curriculum that focuses on MDA and port security. DHS supports scholarships for ten MSI students to participate in this curriculum.

### Goals
- Enhance student knowledge, technical skills, leadership capabilities and interest in maritime security.
- HS workforce development

### Workforce Development
- **Programs Offered:** Undergraduate
- **Courses developed:** None this year
- **Research areas of COE-supported students:** (12)
  - Arctic Environment, Sustainable Power, Marine Robotics, Decision Support, Acoustic Vessel Detection, Ice Acoustics, Underwater Imaging, MDA, port security
- **Student fellowships offered:** Undergraduate and Ph.D. Fellowships
- **Type of COE-supported Students:** Undergraduate, Master’s and Ph.D.

### Collaborations/Partnerships
- **Students engage in research projects and activities in collaboration with** the USCG RDC, Department of State, US Navy, CBP Northern Border, State of Alaska, BOEM

### Experiential Learning:
- Field-based internships via CIMES projects
- Field-based internships and site visits, research presentations at conferences and stakeholder meetings through participation in CSR Summer Research Institute

### Professional Development
- None to report
### Description
- Desk2Deck is designed to place academics into operational environments with stakeholders to yield a better understanding of the tasks and challenges that stakeholders face.

### Goals
- Experience day-to-day activities of DHS stakeholders
- Expose students to hands-on career opportunities
- Enhance COE understanding of stakeholder needs
- Forge stronger stakeholder/researcher partnerships at the inception of new collaboration projects

### Impact & Relevance
- **Impact:** Improved understanding of DHS operations through actual experience will produce better research outcomes, closer collaborations and products that are more finely tuned to their customers
- **Relevance:** Collaboration and communications are two-way streets, but academics are most comfortable in settings where they are the educators. Desk2Deck reverses that model by creating the opportunity for the stakeholders to provide instruction to those who would be conducting research designed to benefit DHS.

### Educational Capabilities & Opportunities
- CIMES placed a faculty member in the field with Hawaii’s 93rd Civil Support Team (CST) and a student in the field with USCG District 14 to evaluate the Desk2Deck concept. Experiences during these joint deployments led directly to modifications of existing research efforts to address stakeholder requirements. As such, both the researchers and the stakeholders received direct benefits from the opportunity. UH has continued a strong collaboration with the CST and several members of their staff have participated in relevant field programs as a result. Joint operations with USCG and Hawaii Civil Support personnel are being planned for April/May 2013.
- CIMES and CSR are brimming with human resources that are highly motivated to experience real-world scenarios for many reasons. These resources can be provided to DHS stakeholders at virtually no cost to enhance understanding of operational needs.
## CIMES Research and Education Successes

<table>
<thead>
<tr>
<th>Accomplishment</th>
<th>Impact/End Users</th>
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</table>
| Remote Power Module                   | - Four years of multi-month data acquisition for previously unmapped ocean currents along the North Slope of Alaska to inform search-and-rescue operations, maritime shipping and future oil spill scenarios  
- Demonstrated ability to detect vessels with CSR Partner, CODAR, HF radars and compare reported AIS positions  
- Funding to fabricate three additional systems for BOEM and NSF in support of ongoing environmental monitoring in the Arctic and Antarctic |
| MSI faculty and student engagement    | - Ongoing undergraduate curriculum at MSI University of Puerto Rico Mayaguez emphasizing careers in homeland security with ten DHS-provided scholarships for minority students to participate in this curriculum                                                                                   |
| Stakeholder Engagement and Outreach   | - October 2013 demonstration for Unmanned Port Security Vessel with USCG District 14/Sector Honolulu and CBP Office of Field Operations  
- February 2013 participation in Joint-Interagency Field Experimentation to support DHS Office of Health Affairs and others  
- Briefings at USCG R&D Center and USCG PACAREA  
- Regular meetings with stakeholders |
Supplemental Material
## CSR Partners

### Principal Partners

<table>
<thead>
<tr>
<th>Principal Partners</th>
<th>Areas of Expertise/Core Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rutgers University</td>
<td>HF Radar Sensing, Ocean Observation, Autonomous Underwater Vehicles, Data Fusion, Signal Processing, Pattern Recognition</td>
</tr>
<tr>
<td>University of Miami</td>
<td>Marine and Atmospheric Science, Satellite Sensing, Synthetic Aperture Radar</td>
</tr>
<tr>
<td>Massachusetts Institute of Technology (MIT)</td>
<td>Supply Chain Management, Port Resilience, Transportation Logistics</td>
</tr>
<tr>
<td>University of Puerto Rico, Mayaguez*</td>
<td>Caribbean Regional Oceanography, HF Radar Sensing</td>
</tr>
<tr>
<td>Monmouth University</td>
<td>Emergency Operations and Response</td>
</tr>
</tbody>
</table>

### Extended Partner Network

**Non-University Partners:** The Mattingley Group, Port Authority of New York and New Jersey, 4D Security, CODAR Ocean Sensors Nansen Environmental Remote Sensing Center, Pacific Basin Development Council  
*Indicates MSIs
# CSR Student Placements

<table>
<thead>
<tr>
<th>Placements</th>
<th>Internships</th>
<th>Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DHS</strong></td>
<td>USCG – Sector New York and the USCG Atlantic Area Operations Analysis Division in Norfolk, VA.</td>
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</tr>
</tbody>
</table>
| **Federal Government**  | U.S. Navy – Naval Undersea Warfare Center, Newport, RI, and the Naval Surface Warfare Center, Carderock. | Pacific Northwest National Laboratory – Deputy, Physical Infrastructure Protection Specialist
                                                                       | NATO/CMRE – Visiting Researcher
                                                                       | U.S. State Dept. – Program Officer |
| **State and Local Government** | MTA- New York City Transit | MTA-New York City Transit – Enterprise Asset Management |
| **Industry**            |                                                                            | Unishippers Global Logistics – Maritime Logistics Consultant |
| **Private Sector**      | Parson Brinckerhoff                                                      | Parson Brinckerhoff – Ports & Intermodal Planner
                                                                       | 4D Security - Analyst |
| **Academia**            | Lloyd’s Register Foundation Research Collegium – Coastal Eco-Cities, Univ. of Southampton, England | Stevens Institute of Technology – Research Assistant
                                                                       | SUNY Maritime College - Professor
                                                                       | Maritime Institute of Technology – Instructional Design Coordinator |
                                                                       | PAN-American Advanced Studies Institute – Brazil |
## CSR Research Areas

<table>
<thead>
<tr>
<th>Research Area</th>
<th>Approaches</th>
<th>Expected Uses</th>
<th>Customers</th>
<th>COE Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Maritime Domain Awareness</strong></td>
<td>▪ Sensor development&lt;br&gt;▪ Threat signature understanding&lt;br&gt;▪ Data analysis and integration&lt;br&gt;▪ Real-time information delivery</td>
<td>▪ Real-time, all-weather, day/night, multi-layer maritime surveillance from the open ocean to estuaries, harbors and inland waterways, all at high resolution</td>
<td>▪ USCG&lt;br&gt;▪ CBP&lt;br&gt;▪ Navy&lt;br&gt;▪ NGA&lt;br&gt;▪ NOAA</td>
<td>▪ University of Miami&lt;br&gt;▪ Rutgers University&lt;br&gt;▪ University of Puerto Rico&lt;br&gt;▪ Stevens Institute of Technology&lt;br&gt;▪ Monmouth University</td>
</tr>
<tr>
<td><strong>2. Marine Transportation System Resiliency</strong></td>
<td>▪ Data gathering&lt;br&gt;▪ MTS modeling&lt;br&gt;▪ Scenario-based assessments of risk and vulnerability</td>
<td>▪ Guidance and tools provided to major MTS decision makers, in both the public and private sectors</td>
<td>▪ USCG&lt;br&gt;▪ Port Authorities&lt;br&gt;▪ DOT&lt;br&gt;▪ CMTS</td>
<td>▪ Stevens Institute of Technology&lt;br&gt;▪ Massachusetts Institute of Technology&lt;br&gt;▪ The Mattingly Group</td>
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</table>
CSR Highlights

<table>
<thead>
<tr>
<th>Accomplishment</th>
<th>Impact</th>
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<tbody>
<tr>
<td>Developed a passive acoustic sensor system that can be used to detect,</td>
<td>▪ Licensed to Sonardyne, Inc. in 2013.</td>
</tr>
<tr>
<td>characterize, and track threats including underwater, surface water, and</td>
<td>▪ Adopted by Navy as a component of the Integrated Swimmer Defense System</td>
</tr>
<tr>
<td>airborne</td>
<td>▪ Under trials to support CBP border aircraft surveillance</td>
</tr>
<tr>
<td>Developed algorithms to facilitate the rapid and accurate analysis of</td>
<td>▪ Around-the-clock critical observation, monitoring, prediction,</td>
</tr>
<tr>
<td>satellite-based Synthetic Aperture RADAR, with delivery times of</td>
<td>and coordination to multi-agency Federal and Local emergency response</td>
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<tr>
<td>less than one hour</td>
<td>to the Deep Water Horizon Oil Spill</td>
</tr>
<tr>
<td>Developed algorithms to facilitate the multi-use of HF RADAR</td>
<td>▪ Adoption by USCG in Search and Rescue (SAROPS)</td>
</tr>
<tr>
<td>systems for the detection and tracking of surface vessels and the wide-area</td>
<td>▪ Being configured via DHS and U.S. Navy Open Mongoose for use in Arctic</td>
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<tr>
<td>synoptic measurement of ocean surface currents</td>
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<tr>
<td>Developed Port Mapping Tool and Port Capacity data to assist in the allocation</td>
<td>▪ Understand the capacity constraints that affect the potential</td>
</tr>
<tr>
<td>of cargo during a port disruption</td>
<td>resilience of the U.S. Maritime Transportation System</td>
</tr>
<tr>
<td>Integration of Satellite-based wide area surveillance, HF Radar systems</td>
<td>▪ Attain surface and underwater vessel detection, classification,</td>
</tr>
<tr>
<td>providing over-the-horizon surveillance of the approaches, and near shore</td>
<td>identification, and tracking to provide comprehensive MDA</td>
</tr>
<tr>
<td>and harbor surveillance systems centered on underwater acoustic technologies</td>
<td></td>
</tr>
<tr>
<td>Delivered maritime security-centric professional development programs</td>
<td>▪ Port Awareness, Port Security Sensing Technologies, and topical seminars. Participants have included practitioners from CBP, USCG, NYPD, NJ OHSP.</td>
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<tr>
<td>including short-courses, workshops and seminars in collaboration with CSR</td>
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<tr>
<td>stakeholders.</td>
<td></td>
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<tr>
<td>Developed an eight-week intensive Summer Research Institute (SRI) designed</td>
<td>▪ More than 70 students from 16 universities have engaged in the SRI.</td>
</tr>
<tr>
<td>to provide engineering and science undergraduate and graduate-level students,</td>
<td>▪ More than half of the student participants have been women or students from underrepresented communities.</td>
</tr>
<tr>
<td>with an opportunity to collaborate with CSR researchers and stakeholders to</td>
<td>▪ The Summer Research Institute has enhanced student technical skills, knowledge and interest in the Maritime/HS domain.</td>
</tr>
<tr>
<td>develop innovative and novel solutions to complex maritime security issues</td>
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## CIMES Partners

<table>
<thead>
<tr>
<th>Principal Partners</th>
<th>Areas of Expertise/Core Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Hawaii*Ŧ</td>
<td>High-Frequency Radars, Passive and Active Acoustics, Unmanned Vessels, Satellite and Airborne Hyperspectral Data Analysis</td>
</tr>
<tr>
<td>University of Alaska FairbanksŦ</td>
<td>Arctic Coastal Radars, Unmanned Aerial Systems, Remote Power Sources, Satellite Data Analysis and Product Development</td>
</tr>
<tr>
<td>University of Puerto Rico, Mayaguez*Ŧ</td>
<td>Passive Acoustics, Satellite Data Analysis</td>
</tr>
<tr>
<td>Intelesense, Inc.</td>
<td>Situational Awareness, Ruggedized Sensors</td>
</tr>
</tbody>
</table>

### Extended Partner Network

**Non-University Partners:**
Furuno, Reson, Teknologic, Battelle Memorial, Moore Foundation, Bureau of Ocean Energy Management, Shell Oil, Alaska North Slope Borough, State of Hawaii Department of Transportation

**University Partners TCHAR**:
University of Delaware, Woods Hole Oceanographic Institution, Laurea University (Finland), Hokkaido University (Japan)

* Indicates MSIs

Ŧ Indicates partners with education expertise and capabilities
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<td>DHS</td>
<td></td>
<td>USCG Academy – Instructor, Science Dept.</td>
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<tr>
<td></td>
<td></td>
<td>USCG Ice Patrol and USCGC HEALY – Operations Officer</td>
</tr>
<tr>
<td>Federal Government</td>
<td></td>
<td>NOAA Coastal Reef Mapping – Scientist</td>
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<tr>
<td></td>
<td></td>
<td>NASA – Engineering Consultant</td>
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<tr>
<td>State and Local Government</td>
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<td></td>
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<tr>
<td>Industry</td>
<td></td>
<td>ERC, Inc. (provides independent assessment, IT, and operations and maintenance support to US Department of Defense, NASA, and commercial clients) – Data Fusion/Software Developer</td>
</tr>
<tr>
<td>Private Sector</td>
<td>Intelesense Technologies</td>
<td>Bishop Museum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KFS, Inc. – Structural Engineer</td>
</tr>
<tr>
<td>Academia</td>
<td>Stevens Institute Summer Research Institute</td>
<td>Universidad Autonoma del Carmen (Mexico) – Professor</td>
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<tr>
<td></td>
<td></td>
<td>University of Puerto Rico Mayaguez – Instructor</td>
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<tr>
<td></td>
<td></td>
<td>UC Berkeley – Doctoral candidate</td>
</tr>
</tbody>
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### CIMES Research Areas

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<th>COE Partners</th>
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</thead>
</table>
| Arctic Maritime Domain Awareness | - Satellite image analysis used for regional ice mapping  
- Unmanned aerial system performance evaluation and high-resolution ice mapping  
- Marine-band radars used for ice and vessel tracking  
- Remote power modules to run systems in extreme environments  
- Automatic information system monitoring in remote regions  
- HF radars for current mapping and vessel detection  
- Passive acoustic monitoring of ships, ice fracture, marine mammals  
- Underwater imaging of structures with Coda Octopus  
- Deployment, testing and winterization of ruggedized sensors  
- Development and testing of situational awareness tools  
- Multi-modal demonstration exercises | - Improve vessel navigation in the Arctic  
- Improve measurements of sea ice thickness and movement  
- Create baseline dataset to assist with oil spill recovery and maritime accidents in the Arctic  
- Provide data for search-and-rescue operations  
- Model ice breakout from shore  
- Provide persistent power in extreme environments  
- Monitor marine mammals for environmental protection and as potential colliders  
- Provide a common operating picture and situational awareness tools to assist tactical operations | - USCG  
- CBP  
- OHA  
- FEMA  
- Arctic Shipping and Oil Industry  
- Marine Shipping Industry  
- Navy / NORTHCOM  
- Air Force  
- Alaska North Slope Borough  
- Arctic First Responders | - University of Alaska  
- University of Hawaii  
- University of Puerto Rico Mayaguez  
- Intelesense Technologies |
## CIMES Highlights

<table>
<thead>
<tr>
<th>Accomplishment</th>
<th>Impact</th>
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<tr>
<td>Utilized Unmanned Aerial Vehicles (UAVs) during Arctic Shield 2013 for collection of sea ice imagery</td>
<td>Evaluated strengths and weaknesses of various platforms and sensors as a function of Arctic conditions such as icing in support of USCG RDC interests</td>
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<td>Demonstrated UPSV capabilities in Hawaii in October 2013 for USCG District 14/Sector Honolulu and CBP Office of Field Operations. Displayed UPSV at DHS S&amp;T Innovation Showcase in February 2014</td>
<td>Expanded potential user base and applications for UPSV, strengthened partnership with Battelle Memorial to include joint operations, began developing other demonstration/deployments</td>
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<tr>
<td>Deployed two Remote Power Modules (RPMs), high frequency (HF) radars and an Automatic Information System (AIS) antennas for expanding mapping of currents and vessels during the Arctic Ocean summer</td>
<td>Demonstrated another year of uninterrupted RPM/HF radar performance for four months, despite deployment at more remote location on North Slope of Alaska. Deployed second RPM and sensors built/bought for BOEM.</td>
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<td>Conducted joint field demonstration with Furuno to evaluate the capability of marine-band radars to detect ships in ice</td>
<td>Demonstrated ability to detect USCG icebreaker POLAR STAR in ice using both intensity differences and directionality-based algorithms</td>
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<td>Developed Situational Awareness Tool, collaborate.org, that is available via the Internet and tested it in support of DHS Office of Health Affairs at February 2013 Joint-Interagency Field Experimentation</td>
<td>Enhanced ability of first responders to monitor man-made and natural events as well as the health and vital statistics of personnel in the field</td>
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<td>Continued an undergraduate curriculum at UPRM that focuses on maritime domain awareness and port security. DHS continues support to provide scholarships to ten MSI students participating in the program</td>
<td>Expanding the participation of underrepresented minorities in DHS through an undergraduate MDA-focused curriculum at UPRM, which graduates the largest number of Hispanic students pursuing STEM-based careers in the United States</td>
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