



THE MARITIME SECURITY CENTER (MSC)

**AT STEVENS INSTITUTE OF TECHNOLOGY
HOBOKEN, NJ**

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1. Background

The Maritime Security Center (MSC), a Department of Homeland Security (DHS) Science and Technology (S&T) National Center of Excellence (COE) was established in 2014 as a result of a competition conducted by DHS's Office of University Programs (OUP). MSC is led by Stevens Institute of Technology and this report is based on activities that were conducted by the MSC at Stevens during Year 1.

MSC is composed of a consortium of internationally recognized research universities, including Stevens, MIT, the University of Miami, the University of Puerto Rico, Louisiana State University, Florida Atlantic University, and Elizabeth City State University. The contributions of each partner institution are provided with the corresponding projects in this report.

MSC's mission is to develop both fundamental and applied research to support DHS's and other agencies' maritime security mission goals, including improved detection and interdiction capabilities, enhanced capacity to respond to catastrophic events, and a more secure and efficient Marine Transportation System (MTS). MSC has been focusing on interdisciplinary research, education, and technology transition in maritime security, maritime domain awareness, and extreme and remote maritime environment issues. Our goal is to develop and transition research and technology solutions and educational programs to DHS maritime stakeholders, such as the US Coast Guard, Customs and Border Protection, and other related agencies and to improve capabilities and capacities for preventing and responding to events in the maritime domain.

Given that this is the first year of operation for MSC and that there were some partners that joined the Center later on, the MSC work plan was approved more than seven months after award date. This led to a delay in funding and the start of most projects. Therefore, this report will summarize the activities of the research and education projects that are based on their start date. The report discusses future activities where available and appropriate. The next section describes the research projects.

2. Research Projects

This section discusses the following research projects: Robust Acoustic Communications, Satellite Surveillance, and Port Resiliency. These projects were in the work plan that was approved in February 2015, but the Robust Acoustic Communications project was not started as discussed below. Prior to approving the work plan, Stevens participated in a DHS OUP kickoff workshop with key stakeholders to discuss topics of interest to them.

2.1. Kickoff Workshop

This workshop was held on September 24 and 25, 2014 at the USCG Headquarters in Washington, DC. Key members from DHS S&T, Stevens, University of Alaska, MSC partners, and stakeholders from the Coast Guard and Customs and Border Protection attended the workshop. The main objective for the workshop was for the OUP program to deliver presentations on a range of activities essential to the success of the Center. They

included information about the Cooperative Agreement (terms and conditions), transition, OUP program overview, transition and commercialization, export control issues, OUP education program, communication issues, and information presented by the variety of DHS maritime stakeholders. An entire day was devoted to stakeholders providing information about various maritime domain awareness programs across DHS and opportunities to link researchers to DHS programs. As a result, the workshop was used to help prepare the Center to develop the work plan that was approved in February of 2015.

2.2. Robust Acoustic Communications

University of Connecticut (UConn) was awarded a project by DHS as a result of the partner FOA application. This project was to thoroughly characterize the acoustic communication capabilities in challenging port environments and establish a solid technical foundation for innovative operational solutions involving underwater communications/networking.

On March 5, 2015, after the funding was awarded and during discussions between Stevens and UConn regarding the sub-award process, UConn's Office of Sponsored Research identified a Conflict of Interest between the UConn's Principal Investigator and the University. This resulted in MSC management informing the DHS Program Manager about the issue, which led to a withdrawal of the award and shifting the funds to support another partner application that was awarded a project on Port Resilience. The Robust Acoustic Communications was therefore discontinued and the funds were shifted to another partner, Florida Atlantic University (FAU). Their research project is discussed in Section 2.4 below.

2.3. Satellite Surveillance

2.3.1. Introduction

The purpose of this project is to reformat and test satellite data and products for ingestion into DHS's Coastal Surveillance System (CSS) and Air and Marine Operations Surveillance System (AMOSS), operating at the Air and Marine Operations Center (AMOC) utilizing NIEM (National Information Exchange Model) formats and the OWF (Ozone Widget Framework) architecture. The goal is to reformat and test timely and actionable information to the AMOC. With this test, we want to establish a CSTARS baseline for timeliness and minimum information needed for actionable response. The initial phase of this project was to determine whether reformatted satellite information can be integrated by DHS in a timely manner. The test baseline would consider operator needs (e.g. actionable information to operations for cuing near-real time).

2.3.2. Project Objectives

The overall objective and purpose of this project is to reformat and test satellite data and data products containing information of targets in the maritime domain that are readily incorporated and exploited by the Coastal Surveillance System. A key requirement will be testing of open and/or secure data transmission connectivity with AMOC to transmit satellite data and exploitable products compliant with NIEM format, including OTH-G

format (Over The Horizon-Gold) for integration into AMOSS. Testing is needed to determine which means of transmission (open and/or secure) allows the largest and fastest throughput of data to achieve near-real-time results – (near-real time is defined in part as programming the satellite up to one hour in advance of the constellation pass). Furthermore, we will work with DHS stakeholders to reformat and test data and data products, which would enhance the maritime domain operational picture. The milestones for this project along with their status are presented next.

2.3.3. Research Milestones Met

Milestone: <i>Phase 1 Reformatting & Testing</i>	Performance Metrics	Status / Discussion
1. Establish POC at SRI and execute an NDA with CSTARS.	Contact to implement project.	Complete. April 6, 2015 visit to SRI International in Tampa, FL.
2. Obtain technical specifications of CSS, NIEM and OWF currently implemented at DHS stakeholders.	Information on system specifics.	Complete. NIEM format as formatted by SRI's TMS3Client (Python Client).
3. Modify CSTARS XML and data products to be compliant with M2.	Modifications to generate compliant products.	Complete. Developed (command line) converter to translate CSTARS output to interface with TMS3Client.
4. Test data transfer between SRI and CSTARS to establish baseline transfer times and rates.	Establish data latencies, size limitations, optimal routing.	Complete. Test data successfully injected into SRI Test CSS system.
5. Test integration of all CSTARS data and products into CSS and OWF at SRI.	Data integration at test facility of all available products. Format modifications to be compliant.	Complete. CSTARS integrated TMS3Client into SeaScope – some loose ends exist. New software available now to proceed. However, SRI didn't specify any products.
6. Simulate integration of OTG, XML and image chips with SRI in technical demonstration.	Full scale technical demonstration of integration and transfer process.	Complete. SRI didn't use OTG format. Vessel info and image chips not supported in CSS. No further activity on this.
7. Midterm project meeting with stakeholders to evaluate progress and obstacles of objectives.	Up-to-date achievements and future corrections needed for success.	Not Completed. Meeting didn't happen due to no response from SRI. Emails and calls were not returned. However, the gathering of imagery and investigation of relevant data

		formats continued. A meeting was held with the Stakeholders that will be reported in Y2.
8. Perform simulation test as describe in M4 with AMOC.	Establish data latencies, size limitations, optimal routing with end customer.	Not Completed. See M7.
9. Perform simulation test as describe in M5 with AMOC.	Implement system procedure at end customer.	Not Completed. See M7.
10. Perform “live” test with AMOC of E2E process.	Perform E2E near-real time test.	Not Completed.
11. Final project of Phase 1 to evaluate project goals and achievements and plan next phase.	Evaluate achievements of goals and overall achievements and successes.	Not Completed.

2.4. Port Resiliency

This project is led by Florida Atlantic University. FAU was selected by DHS from a partner application proposal and was expected to join MSC in Year 3. However, due to the issue that arose with UConn, FAU joined us in July 2015 and have not conducted any activities in Year 1. The following provides a brief description of FAU’s Port Resiliency Project that started in Year 2 and will be reported in next year’s annual report.

The principal objective of this project is to develop a cost-effective port resiliency assessment and planning tool that can be adapted, through a choice of interchangeable event modules, to assess and plan for evolving threats and hazards to a port and its waterside and landside distribution capacity, in support of avoidance and mitigation of damage and capacity reduction, and aiding rapid recovery from disruptions

In order to onboard FAU, a number of calls were held with the PI to discuss the Center objectives and projects. The workplan for the FAU project was refined a number of times, including additional tasks for additional funding that was shifted from the Satellite Surveillance Project to this project. The PIs in the Center have worked with the FAU PIs in the past, so the addition of FAU was straightforward. The research team planned to meet with key RDC personnel after the work plan was approved. The RDC agreed to champion the FAU project and work closely with the PI in refining the scope and tasks. Additional activities on this project will be reported in next year’s annual report.

3. Education and Outreach

3.1. Overview

The Maritime Security Center provides educational programs designed to enhance the technical skills and leadership capabilities of current and prospective maritime and homeland security practitioners. The Center's educational programs leverage the subject matter expertise and research assets of its academic partners to provide multidisciplinary hands-on learning opportunities and degree granting programs for students, professionals, stakeholders, and the general public.

During Year 1, MSC continued to offer maritime security-centric programs established under the former Center for Secure and Resilient Maritime Commerce. The programs included the following:

- Summer Research Institute,
- Maritime Systems Seminar Series,
- Maritime Security Master's and Doctoral Fellowship Programs, and the
- USCG Auxiliary Detachment Program at Stevens.

The Center also initiated the development of a new professional development program in conjunction with its academic partners from Louisiana State University (LSU), Stephenson Disaster Management Institute (SDMI) to create maritime incident discussion-based tabletop exercises for maritime security practitioners and port facility operators.

Throughout Year 1, MSC engaged closely with its stakeholders (e.g. U.S. Coast Guard, Customs and Border Protection, New York Police Department – Counterterrorism Division, National Urban Security Technology Laboratory, Sandia National Labs, Port Authority of New York and New Jersey, and the New Jersey Office of Homeland Security and Preparedness, to name a few) to provide unique field-based opportunities for students, feedback on course content and curriculum development, and to identify internship and career opportunities for homeland security career-focused students. This section of the report details the Center's educational programs and outreach activities during Year 1.

3.2. College-level experiential learning and research-based programs

3.2.1. The 2015 Summer Research Institute

MSC held its 6th Annual Summer Research Institute (SRI) during Year 1 (Figure 1 below shows the brochure). The eight-week intensive summer research program took place from June 1 to July 24, 2015 at the Stevens campus in Hoboken, NJ. Over the past six years, 103 students have engaged in the maritime security-focused summer research program, working on projects designed to enhance the situational awareness and decision support capabilities of emergency responders and homeland security professionals. SRI student research outcomes have contributed to the development of new tools and technologies, co-authored papers, presentations at national conferences, and have earned several students the opportunity to intern at DHS component and affiliate homeland security agencies.



Figure 1. SRI 2015 Program Brochure

The Center has been able to track the academic and professional trajectories of its SRI program participants and has facilitated an active and engaged alumni network. The 2015 summer research program included 15 student participants representing the following five universities: Stevens Institute of Technology, University of Puerto Rico-Mayaguez, Brown University, Drew University and the University of Colorado-Boulder. 33% of the student participants were women and 20% were students from underrepresented communities. To support student participation in the 2015 program, the Center leveraged existing Stevens scholarship and fellowship programs and those of its academic partners to recruit students who could attend the SRI fully-funded through externally-funded sources. Ten out of the 15 program participants attended the program through funding support from the Stevens Scholars program and the Brazilian Scientific Mobility Program (BSMP), and one student attended using his own funding source.

The Stevens Scholars Program offers qualified students the opportunity to either participate in undergraduate research or pursue an accelerated program leading to a bachelor's degree in three years or a dual bachelor's /master's degree in four years. The Scholars Program is an invitation-only program in which undergraduates are encouraged to apply their knowledge and participate in hands-on research projects with Stevens faculty members. The summer research opportunities include stipends and on-campus residential housing. The Brazilian Scientific Mobility scholarship program is a one-year program for STEM-focused college students to study abroad at an accredited U.S. institution. The scholarship program provides for tuition, stipend, and housing support for high-potential students, and encourages research-based summer internship opportunities for participants. The two students who participated in the BSMP were enrolled in engineering degree programs at Brown University and Stevens Institute of Technology.

MSC provided funding support for only five out of the fifteen participants. The students were selected through the Center's academic partnership with the University of Puerto

Rico-Mayaguez and through a competitive admission process. The students admitted into the program were endorsed by their academic professors, expressed interest in homeland security concerns, and met the Center's admission criteria. Figure 2 shows a picture of the 2015 SRI participants and Table 1 identifies the participants and the funding sources leveraged to support their participation.



Figure 2. SRI 2015 student participants gather for a group photo on the MSCs 6th Floor observation patio overlooking the Hudson River and west side of Manhattan.

Table 1. SRI 2015 Student Participants

University	Student Participant	Academic Major & Degree Status	Funding Source
Aristotle University of Thessaloniki	Christos Zalidis	Civil Engineering	Attended using personal resources.
Brown University	Raphael De Lima	Mechanical Engineering / Undergraduate	BSMP
Drew University	Alexa Daly	Physics / Undergraduate	MSC
Stevens Institute of Technology	William Cusik	Computer Sci./Undergrad.	Stevens Scholar
	Robert Garvin	Electrical Eng./Undergrad.	Stevens Scholar
	Jack Giambalvo	Mechanical Eng. / Undergrad.	Stevens Scholar
	Samantha Hetherington	Business & Tech. /Undergrad.	Stevens I&E Scholar
	Andressa Knupp		BSMP
	Blaise Linn		Stevens Grad. Assistantship
	Tyler Mackanin	Naval Eng./ Undergrad.	DHS CDG Fellow
	Cory Wiedmann	Maritime Systems/Grad.	
		Maritime Systems / Grad. Mechanical Engineering	Stevens Scholar

Univ. of Colorado – Boulder	Kathleen Umphlett	International Relations / Undergrad.	MSC
Univ. of Puerto Rico - Mayaguez	Fabian Garcia	Mechanical Eng./ Undergrad.	MSC
	Estefania Quinones-Melendez	Mathematics / Physical Oceanography – Grad.	MSC
	Enrique Mas	Electrical Engineering	MSC

Student Qualifications and Documentation

Participation in the SRI required that students be actively enrolled in an undergraduate or graduate-level degree program at an accredited university. Undergraduate students must possess a minimum GPA of 3.0, and graduate-level (Master's and PhD) students are required to have a GPA of 3.5 or better. This past summer's participants were required to complete an online application form, submit a letter of recommendation and write a personal statement of interest. In accordance with Stevens policy, visiting SRI students were also required to demonstrate proof of health insurance and submit immunization records to Stevens Health Center prior to attending the program.

SRI Summer Research Stipends and Housing

Students in the 6th Annual SRI received summer stipends up to \$4,000 and were provided accommodations on campus in the Stevens dormitory housing. Travel reimbursements up to \$1,000 were also made available for transportation to and from the start and end of the program for students residing outside of New Jersey.

SRI Program Administration

The program administration was provided by Ms. Beth Austin-DeFares (Director of Education) and by Dr. Barry Bunin (Director of the Maritime Security Program). Ms. DeFares functioned as the primary program and student coordinator, while Dr. Bunin served as the lead faculty facilitator and curriculum developer. SRI student team mentorship was provided by MSC research members and Stevens faculty including Dr. Barry Bunin, Dr. Julie Pullen (Associate Professor, Ocean Engineering), Dr. Alexander Sutin (Research Professor), and Dr. Alexander Yakubovskiy (Senior Research Engineer) and by Stevens Master's and Doctoral students Blaise Linn (Maritime Systems), Alex Pollara (Maritime Security), and Dr. Talmor Meir (Ocean Engineering).

SRI Program Format and Curriculum

The eight-week program includes a balance of in-class lectures, student team research projects, professional development activities, and field-based learning opportunities. Orientation to the 2015 SRI was conducted during the first two weeks of the program. Student participants attended introductory lectures provided by Dr. Thomas Wakeman (Director Maritime Systems Program) and Dr. Barry Bunin and completed group homework assignments and presentations on the Marine Transportation System, maritime policy, port

facility infrastructure and operations, and the capabilities and limitations of technology platforms for maritime security. During the program orientation, students were also assigned to one of three faculty mentored projects. This summer's research projects included:

- Underwater Acoustics Systems
- Sensor Integration
- Magello Emergency Response – Caribbean Region and NY Harbor

The student teams were organized according to student skills and expressed research areas of interest. Starting Weeks Three to Seven, the program format shifted from time spent in the classroom, to time spent engaging in team research projects and field visits and meetings with Center stakeholders and maritime practitioners. During this four-week period, student teams also began to provide formal status updates on their research in the form of weekly presentations and Power Point slides. Each team was responsible for providing a twenty to thirty minute presentation describing their research project, the challenges they were addressing, the activities and experiments they were engaged in, and the research progress they were making. Throughout Weeks Three to Seven, the students also attended lectures by guest speakers and engaged in field visits to the Port of New York/ Newark and local ferry terminals in Hoboken, NJ, lower Manhattan, and Staten Island, NY. Details regarding guest speakers and field visits are provided later in this report.

In Week Seven, the student teams began to synthesize their research and started to compile their final team research reports with the support of their faculty mentors. In Week Eight, the last week of the summer research program, students submitted their final reports and provided team presentations to an audience of MSC research members and stakeholders from Customs and Border Protection, the U.S. Naval Facilities Command, and the Port Authority of New York and New Jersey.

Tables 2 and 3 below illustrate the program activities and guest speakers for each week of the 2015 SRI. Guest speakers provide insight into the current state of practice in the homeland security domain. SRI students are encouraged to ask questions and take advantage of the opportunity to engage practitioners and experts in a dialog as it pertains to their respective research projects and general academic and career interests.

Table 2. SRI 2015 Program Activities Weeks One to Eight.			
Schedule	Topic	Faculty /Guest Speakers	SRI 2015 Activities
WEEK ONE June 1 – 5	MDA/MTS Industry Overview	Dr. Thomas Wakeman – Maritime Domain Orientation	Introductions, team assignments. Security and vulnerabilities observations - field visits to ferry terminals.

WEEK TWO June 8 - 12	Sensor Technologies / Platforms	Dr. Barry Bunin – Sensors Orientation Chris Francis –CMRE MDA platforms Dr. Brendan Englot – ROVs and Maritime Security applications David Warrington – PANYNJ – Risk Assessment	Area Maritime Security Committee (AMSC) – Members at Large Meeting, Brooklyn, NY.
WEEK THREE June 15 - 19	Team Research Projects	Dr. Phil Vital – Naval Facilities Engineering Command – Security of Undersea Cables Dr. Charles Potter – Sandia – Domain Awareness for Radiological & Nuclear Security	Status Update Presentations
WEEK FOUR Jun. 22 – 26	Team Research Projects	Dr. Philip Orton – Dynamic Modeling of Storm Surge and Flood Mapping – Coastal Communities	CBP – Visit to the Port of New York/Newark Status Update Presentations
WEEK FIVE June 29 – July 3	Team Research Projects		Status Update Presentations
WEEK SIX July 7 – 11	Team Research Projects		Status Update Presentations
WEEK SEVEN July 14 - 18	Research Synthesis		Presentation Rehearsals
WEEK EIGHT July 21 - 25	Team Reports	Guests: Noel Maloney & Scott Rutledge, CBP Bethann Rooney, PANYNJ Dr. Philip Vital, Naval Engineering Facilities Command	Final Research Team Presentations

Table 3. SRI 2015 Guest Speakers		
Guest Speaker	Organization	Lecture Topic
Dr. Brendan Englot	Stevens Institute	ROVs and Port Security Applications
Mr. Chris Francis	Stevens Institute (formerly a Visiting	Testing and Evaluating Layered Technologies for Harbor Security

	Researcher with NATO-CMRE)	
Dr. Philip Orton	Stevens Institute	Dynamic Flood Mapping
Dr. Charles Potter	Sandia National Labs	Domain Awareness for Radiological and Nuclear Security
Dr. Philip Vital	Naval Engineering Facilities Command	Security of Undersea Cabling
Mr. David Warrington	Port Authority of NY/NJ	Risk Assessment and Management
Dr. Alex Wellerstein	Stevens Institute	Dynamic Modeling of Plume Dispersions

SRI Field Visits and Meetings with Practitioners

Field visits to ports and homeland security operational facilities where maritime and homeland security practitioners conduct their day-to-day operations are an important aspect of the SRI. Field visits provide a unique opportunity for students to go behind the scenes and experience the responsibilities of homeland security professionals in the field (see Figure 3 below).



Figure 3. CBP Officers John Voloshin and Daniel Canzano meet with SRI students and discuss the use of radiation portal monitors to scan cargo containers as they exit the Port.

During the 2015 SRI, students participated in field-visits and engaged in activities with representatives from the following organizations:

- Customs and Border Protection (CBP) Tactical Operations Division – Field visit
- DHS National Urban Security Technology Laboratory (NUSTL) – Urban Operational Experimentation – Field visit
- U.S. Merchant Maritime Academy – Field visit and Experiment
- USCG Incident Management Division – Meeting

Over the past four years, Customs and CBP has hosted the Center's SRI students for a comprehensive tour of the agency's facilities at the Port of New York/Newark. On June 23,

2015, CBP welcomed the latest cohort of MSC summer research students for a discussion of the agency's mission areas and a tour of the organization's Tactical Operations Division. Coordinated by Officer Daniel Canzano, Supervisor, Port of New York/Newark the visit included observations of CBP's radiation portal monitors, high-energy mobile non-intrusive inspection (NII) equipment, and a tour of a Centralized Examination Station warehouse where cargo is physically inspected and analyzed and agricultural specialists examine agricultural products for pests and invasive species. The engagement of SRI students in field visits and networking events with MSC stakeholders have resulted in invitations for students to attend other local and regional homeland security activities, including tabletop and full-scale exercises, law enforcement and emergency response training events, and harbor security patrols with the U.S. Coast Guard.

This past summer, student participants were invited to observe and take notes at the NUSTL inaugural Urban Operational Experimentation for first responders. Since the event was held the week following the end of the SRI, only the Stevens Scholars and DHS CDG Fellowship students were able to participate. Additional invitations included participation in a full-scale emergency exercise being held by the Port Authority of NY/NJ this fall at Newark International Airport and volunteer support to the Hoboken Civil Emergency Response Team during the fall Arts Festival in Hoboken.

SRI 2015 Student Research Projects

Student participants in the 2015 SRI were assigned to one of three research project teams. These teams are described next.

Underwater Acoustics Systems Team

The Underwater Acoustics team (see Figure 4 below) explored ways to improve the Center's current passive acoustic systems, Stevens Passive Acoustic Detection System (SPADES) and the mobile Passive Acoustic Recorder System (PARS). Based on this assessment, areas for potential future improvement were identified for both the SPADES and PARS systems. Key areas included cost, portability, and data quality. The student team then designed and fabricated a prototype recording system to show the feasibility of such features. This prototype was based on the Intel Edison microcomputer and incorporated a rechargeable battery and the potential to incorporate peripheral sensors in addition to hydrophones.

The final prototype incorporated a four-hydrophone array to provide a larger detection area, a magnetometer/accelerometer for positioning data, and a real time clock module for data time stamping. The team outcomes resulted in the development of Stevens Passive Acoustic Recorder (SPAR), a low-cost, high-efficiency, multi-sensor underwater recording platform. Outcomes from the team's research included a research report outline and a presentation to MSC stakeholders from Customs and Border Protection (CBP), the Port Authority of New York and New Jersey (PANYNJ), and the U.S. Navy Engineering Facilities Command.



Figure 4. Students on the Underwater Acoustics Systems team conduct research to develop a mobile, modular passive acoustic monitoring system in the MSC Maritime Security Laboratory.

Table 4 below includes a list of the students and faculty mentors for the Underwater Acoustics Team. Details regarding the Team's project and research outcomes can be found in their final presentation slides located on the MSC SRI website at: <http://www.stevens.edu/ses/SRI%202015>.

Table 4. Underwater Acoustics Team

Student	Academic Discipline	School
Jack Giambalvo	Mechanical Engineering	Stevens Institute of Technology
Enrique Mas	Electrical Engineering	University of Puerto Rico-Mayaguez
Estefania Quinones-Melendez	Mathematics/Physical Oceanography	University of Puerto Rico-Mayaguez
Cory Wiedmann	Mechanical Engineering	Stevens Institute of Technology
Faculty Mentors: Alex Pollara (DHS CDG Doctoral Fellow), Dr. Barry Bunin, Dr. Alexander Sutin		

Sensor Integration Team

The Sensor Integration Team (see Figure 5) explored ways to enhance the situational awareness and surveillance capabilities of homeland security practitioners by combining sensor information from radar systems with images from high-resolution cameras. The team's research focused on data fusion and the ability to synchronize radar detections with data collected from optical sensors. In assessing the stand-alone capabilities of each sensor, the team found that radar cannot easily classify detected objects, that is it cannot determine what type of target it detects. On the other hand, cameras can provide valuable

information as to the nature of the target, but have a limited field of view. The team’s goal was to integrate the capabilities of both radar and optical sensors into one interface.

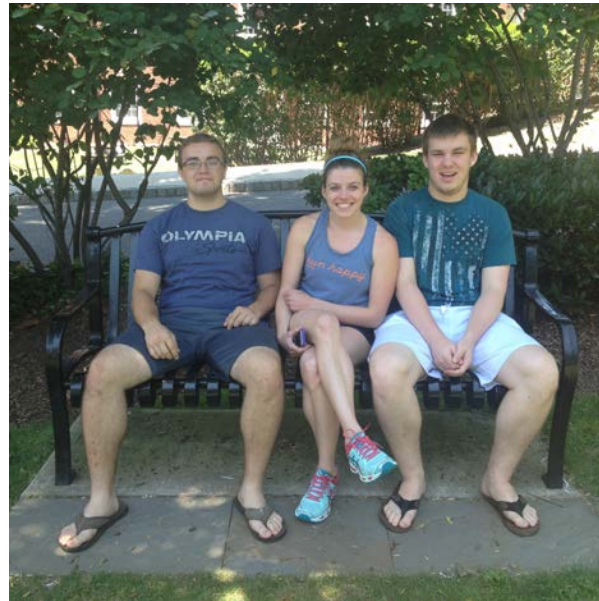


Figure 5: Students from the Sensor Integration team conducted research to synchronize data from optical sensors and radar detections.

To accomplish this data fusion goal, the team worked to mathematically synchronize radar data and camera images. The team’s research took into consideration the need to calibrate camera images to match the real world by removing lens distortions. The team then aligned the images with the radar data to provide a unified data display. After several mathematical challenges, the team’s research outcomes included the development of a proof of concept, in which they were able to align images from optical sensors with radar data. Outcomes from the team’s research included a research report outline and a presentation to MSC stakeholders from CBP, the PANYNJ, and the U.S. Navy Engineering Facilities Command. Table 5 below includes a list of the students and faculty mentors for the Sensor Integration Team. Details regarding the Sensor Integration Team’s project outcomes can be found in their final presentation slides located on the MSC SRI website at: <http://www.stevens.edu/ses/SRI%202015>.

Table 5. Sensor Integration Team Members

Student	Academic Discipline	School
William Cusick	Computer Science	Stevens Institute of Technology
Alexa Daly	Physics	Drew University
Robert Garvin	Electrical Engineering	Stevens Institute of Technology
Blaise Linn (Team Leader)	Maritime Systems / Mechanical Engineering	Stevens Institute of Technology
Faculty Mentors: Dr. Barry Bunin and Dr. Alex Yakubovskiy		

Magello Emergency Response Team

The Magello Emergency Response team (see Figure 6 below) focused on enhancing the Center's Magello web interface to incorporate new data sets for the Caribbean region and enhanced functionality for the NY Harbor. The inspiration behind the team's research included a Statement of Work the MSC had prepared for the USCG Seventh District (D7) in Miami, FL, to assist in their efforts to prepare for and respond to oil spills and crisis events in the Caribbean region. The original plan was created in response to conversations MSC researchers and administrators had with CDR Kim Chesteen, Chief, Contingency Preparedness and Exercise Branch, D7 and CDR Paul Lattanzi, USCG International Maritime Organization Consultant assigned to the Regional Marine Pollution Emergency Information and Training Center for the Wider Caribbean (REMPEITC-Caribe), to identify common operating platforms for environmental crisis events.



Figure 6: Students from the Magello Emergency Response Team meet with members from the USCG Sector New York Incident Management Division for a discussion on the tool's spill modeling capabilities for the New York Harbor.

Based on Magello's capabilities to provide and visualize current and forecasted oceanic and atmospheric data sets for the New York Harbor, San Francisco, CA, and Puerto Rico, D7 and REMPEITC representatives inquired if Magello could be enhanced to include pertinent data sets for the Caribbean region. The data sets and visual overlays discussed included:

- AIS data for the Caribbean region,
- GIS spatial data for the Caribbean,
- Coastal HF radar data from CariCOOS and NOAA IOOS,
- Environmental and oceanic data provided by other nations (e.g. Cuba, Bahamas, etc.),
- Hurricane and extreme weather tracking capabilities, and
- Air/Sea high-resolution modeling.

The students assigned to the SRI 2015 Magello Emergency Response team were therefore tasked with identifying available and pertinent data sets for the Caribbean and

helping to enhance the spill modeling capabilities of the tool. At the start of the summer research program, the team learned that Google was no longer going to support Google Earth™, the platform in which Magello operates. Given this setback, the team moved forward to research available oceanic and environmental data sets, however, they were not able to simultaneously incorporate them into Magello until the tool could be transitioned to a new compatible platform. During the eight-week program, the team's objectives were to identify ocean and atmospheric numerical models (e.g., weather and surface currents) for the Caribbean, identify available observation equipment used by NOAA and other scientific organizations to collect data, to characterize ports in the Caribbean region according to their emergency response capabilities, and to extend Magello's functionality to include waterborne spill simulations.

In an assessment of available oceanic and atmospheric models, the team identified several disparate data sources that could potentially be integrated and displayed into Magello, including the following:

- Hybrid Coordinate Ocean Model (HYCOM) – provides real-time ocean state conditions (including the legacy Navy Coastal Ocean Model)
- Regional Ocean Modeling Systems (ROMS) – provides ocean temperature data
- Ocean Surface Current Analyses – Real time (OSCAR) – provides real-time surface current information
- Cuba Weather (Buoyweather) – provides marine weather forecasting for Cuba and the surrounding islands
- National Digital Weather Forecast Database – provides readily available weather forecast information in digital formats

Together, these sources could be integrated into data layers within Magello to provide important data for the USCG and its Caribbean partners in their emergency response operations and needs for regional situational awareness. The team also conducted research on port facilities in the Caribbean. Through their literature and online data reviews, they assessed that a classification and categorization for the Caribbean region's ports did not currently exist. Given the importance of such data to assist in the coordination of emergency response during crisis events, for example a cruise ship accident or an oil spill, the team focused their efforts on creating a port classification in the Caribbean. The team identified the following characteristics as important to classifying the ports:

- Type of port (e.g. offshore terminal, seaport, harbor or a pier)
- The area of the port (e.g. land and water area, including berths and container storage)
- Anchorage depth – infers the types of vessels that can be accommodated and docked at the port.
- Available equipment and infrastructure (e.g. cranes and forklifts)

Another aspect of the team's research focused on enhancing the use of NOAA's GNOME spill modeling to simulate waterborne oil spills in the NY Harbor and Caribbean Sea. Due to the time constraints of the summer research program and the complexities of the ocean

currents in the Caribbean, the team decided to focus their efforts on enhancing the visualization and spill simulation capabilities for the New York Harbor.

In a meeting with the USCG Sector New York Incident Management Division, the team was able to walk through a hypothetical spill of 160 barrels of a non-weathering pollutant spill from a combined sewer overflow location using surface current data from Stevens New York Harbor Observing and Prediction System (NYHOPS) and winds from the North American Mesoscale Forecast System (NAMS). Once Magello has been transitioned to a new platform, the team would like to visualize and integrate the spill simulation with other data sets available in Magello, including surface currents and velocities and near surface winds and shoreline sensitivity index for more precise spill modeling predictions. Concurrent to the team's focus on the gathering data for the Caribbean, one student assessed prospective operating platforms for transitioning Magello. The student reviewed a number of platforms and determined that Magello should be moved from a web-based interface to a commercial geospatial software system capable of providing visualization, data fusion, and data processing and analysis. The Center is currently considering the team's suggestion and is looking to leverage the support of a web developer to assist with the transition and ongoing maintenance of Magello.

A copy of the team's presentation slides was provided to CDR Kim Chesteen and CDR Paul Lanttanzi for their review and input. CDR Lanttanzi expressed his appreciation for the team's work and offered his continued assistance in helping the Center enhance Magello for the Caribbean region. Outcomes from the team's research included a research report and a presentation to MSC stakeholders from CBP, the PANYNJ, and the U.S. Navy Engineering Facilities Command. Details regarding the Team's project outcomes can be found in their final presentation slides located on the MSC Summer Research Institute website at: <http://www.stevens.edu/ses/SRI%202015>

Table 6 below includes a list of the students and faculty mentors for the Magello Emergency Response Team.

Table 6. Magello Team Members

Student	Academic Major	School
Rafael De Lima	Mechanical Engineering	Brown University
Fabian Garcia	Mechanical Engineering	University of Puerto Rico-Mayaguez
Samantha Hetherington	Business and Technology	Stevens Institute of Technology
Andressa Knupp	Naval Engineering	Stevens Institute of Technology
Tyler Mackanin	Maritime Systems/Naval Engineering	Stevens Institute of Technology
Katie Umphlett	International Relations	University of Colorado - Boulder
Christos Zalidis	Civil Engineering	Aristotle University
Faculty Mentors: Dr. Talmor Meir and Dr. Julie Pullen		

SRI 2015 Program Survey

An assessment of the SRI 2015 program was conducted via a post-program student survey (see Appendix 1 for a copy of the SRI 2015 student survey questions and format.). Student participants were each asked to complete an online survey and to provide feedback on the strengths and weaknesses of the program, the student's learning gains over the eight-week program, areas for program improvement and program impacts on student interest in advanced study and/or careers in homeland security. Eight out of the 15 student participants completed the online survey. A majority of the survey respondents rated the SRI "Excellent" in:

- Quality of Guest Lectures (50%)
- Quality of Research Facilities (37%)
-

The SRI rated "Very Good" in:

- Quality of Program Administration and Coordination (50%)
- Quality of Program Curriculum (50%)
- Quality of Faculty Lectures (62%)
- Quality of Field Visits (50%)
-

Areas rated "Good" included:

- Faculty Mentor Guidance and Assistance (50%)
- Quality of Research Outcomes (62%)
- Ability to be Self-motivated and Innovative (50%)

A majority of the student respondents reported the following items as their top three takeaway's from the program: Teamwork/Collaboration, Oral Presentation Skills, and Research. Students commonly reported the following areas for program improvement: more opportunities for field-visits, fewer lectures and more time to conduct team research, and better align faculty and guest lectures with the student research projects. Students reported the following program strengths:

- "The student teamwork, stakeholder meetings, and the administration are all strengths of the SRI."
- "I think the faculty expertise (e.g., Barry, Alex, and Dr. Sutin) were great resources and provided useful advice from time to time. Beth and the SRI also did a good job of keeping everyone engaged and giving us opportunities to see things and meet people we never would have otherwise."
- "The collaboration and interaction between the end users, the mentors, and the students."

Seventy-five percent of the survey respondents said that the SRI enhanced their interest in advanced academic study and careers in the homeland security domain and all respondents reported that they would recommend the program to their peers and colleagues at their respective schools. The students worked in close collaboration with

MSC researchers and had the unique opportunity to interact and engage with real-world industry and government maritime and homeland security leaders and practitioners. Through their experience in the summer research program, students gained a greater awareness of maritime security issues and the vital role of the marine transportation system to the nation's economy. Because of their experience in the SRI program, several of the students will now consider seeking jobs and careers in areas that will contribute and support to U.S. homeland security. Overall, the SRI was effective in achieving the following outcomes:

- Student research reports, field experiments and weekly presentations demonstrated the student's advanced knowledge and understanding of the maritime security domain.
- Students enhanced their professional skills by providing weekly research presentations and through networking opportunities with MSC stakeholders.
- Students expressed enhanced interest in pursuing careers and/or advanced academic study in maritime/homeland security as a result of their participation in the SRI.

Lessons learned in this year's program demonstrate that student research outcomes are positively affected by the following factors: the amount of time spent conducting research, collaborations and engagement with MSC researchers and industry and government practitioners, and access to state-of-the science tools and technologies.

SRI Program Recommendations

The following recommendations for the future delivery of the SRI take into consideration conversations held between MSC researchers and administrators and specific comments received in the student survey responses.

Program Format: MSC administrators must continue to refine the program format to allow students sufficient time to work on their research projects.

In-Class Lectures: Faculty and guest speaker lecturers should be better aligned with the research projects the students are engaged in. While general homeland security topics are of interest and value to building a broad understating of the maritime domain, students have responded that they would benefit from more targeted discussions pertinent to their SRI research projects.

SRI Program Publications

MSCs director of education in conjunction with Stevens faculty members successfully published two peer reviewed publications highlighting the impacts of the Center's SRI on inspiring STEM student interest in maritime and homeland security education and careers. The citations for the two publications include:

- DeFares, B., Pullen, J., and Bunin, B. (2014) Maritime Security Summer Research Institute, Cases on Research and Knowledge Discovery: Homeland Security Centers of Excellence, Chapter 5, IGI Global Press, and
- Austin-DeFares, Beth and Bunin, B., (2015) The Impacts and Benefits of Engaging STEM Students in Maritime Security Research, Marine Technology Society Journal, Blue Futures: Educating the Next Generation, pp. 45-52(8)

SRI Alumni Network and Student Achievements (2010 – 2014)

MSC administrators have actively worked to cultivate an active and engaged SRI alumni network. The Center recognizes the importance of the SRI program alumni to serve as program ambassadors, professional mentors for current and prospective SRI program participants, and important advocates for promoting internship and career opportunities within the maritime and homeland security domains. Alumni outreach methods include email distributions, communications via social media, and follow-up program surveys.

During Year 1, the Center conducted a survey to assess the impacts of the Summer Research Institute on the education, career choices and employment of its program alumni for Years 2010 to 2014. 21 students out of the program's 88 alumni responded to the survey. Students from the program's 2010 were the largest group of respondents, followed by the 2014 and 2011 SRI cohorts. 44% of the alumni respondents reported that they were currently employed fulltime in the workforce and 24% said that they were employed and attending college/graduate school simultaneously. Out of the students who reported employment in the workforce (fulltime and employed attending college/graduate school simultaneously), 50% reported that their occupation was homeland security/maritime security related.

For those students who reported that they were currently enrolled in college/graduate school, 33% said that they were interested in pursuing employment in the homeland security/maritime security domain following the completion of their degrees and 55% said that they would like to pursue homeland security employment, but it depended on the position and the employment opportunity. 90% of the alumni survey respondents reported that the SRI positively impacted their professional development and skills, and 81% said that to their knowledge, their experience in the SRI assisted them in obtaining employment, an internship, and/or a fellowship/scholarship opportunity. 86% of the students said that they stayed in communication with their SRI program peers and a majority of the respondents encouraged MSC administrators to create an SRI alumni group page on LinkedIn to enhance professional connections across the program participants. In response to the SRI 2010 – 2014 alumni survey, MSC has created an SRI Alumni Group page and has gathered a diverse group of 35 alumni members. The LinkedIn page has already been used to solicit alumni suggestions for topics and guest speakers for the Center's Maritime Systems Seminar Series.

SRI Alumni student achievements:

The bulleted list below provides specific examples in which SRI student alumni are continuing to engage in homeland security related academic or professional activities.

- **Blaise Linn** has participated in the SRI for four consecutive summers under the Stevens Scholars Program and has been recently funded through a Stevens Graduate Assistantship. Following the completion of his undergraduate degree in Mechanical Engineering from Stevens in May 2015, Blaise was admitted into the Maritime Systems Master's Degree program and awarded a Stevens Graduate Research Assistant position.
- **Gina Salmins** (SRI 2014) and **Nicholas Monzillo** (SRI 2013) were each selected to participate in internship positions at the National Urban Security Technology Laboratory in New York City. The students participated in activities that provided technical support to first responders, conducted market research on current tools and technologies, and prepared reports for publication. The students were recognized for their quality of work by their internship advisor, Dr. Lawrence Ruth, Director at NUSTL Systems Division.
- **Sarah Walsh** (SRI 2014) was offered an internship position within the National Infrastructure Simulation and Analysis Center at Sandia National Laboratories during the summer of 2015. Sarah conducted research on an Urban Growth Model. Sarah's quality of work earned her a one-year technical internship with Sandia and the opportunity to apply for Sandia's Critical Skills Master's Program.

3.3. Maritime Security Master's and Doctoral Fellowship Programs

MSC Supported Students

In addition to the five students supported by the MSC during the 2015 Summer Research Institute, the Center has also provided support in the form of a Research Assistantship to Talmor Meir, a doctoral candidate in Stevens Ocean Engineering Ph.D. program. In the spring of 2015, Ms. Meir successfully defended her doctoral dissertation titled "*Characterizing Atmospheric Transport Processes in the Complex Urban-Coastal New York Metropolitan Region*", to achieve her doctorate degree in Ocean Engineering from Stevens. During the summer of 2015, Dr. Meir served as a faculty mentor in the MSC Summer Research Institute, and led a team of seven undergraduate and graduate-level students to enhance the Center's Magello Emergency Response Tool to include data sets for the Caribbean Region and GNOME spill modeling capabilities for the New York Harbor. At the end of the summer research program, Dr. Meir accepted employment as an Actuarial Analyst with Verisk Analytics.

Mechanical Engineering and Homeland Security Doctoral Fellowship – DHS Career Development 2015 Supplement Award

During the spring of 2015, the Center prepared a work plan in support of a Career Development Supplement to develop a new doctoral fellowship in Mechanical Engineering and Homeland Security. Awarded in July 2015, MSC in conjunction with Stevens Institute of Technology faculty will make available a fully-funded fellowship award for one student throughout a rigorous and comprehensive research-based doctoral program in mechanical engineering with a concentration in maritime and homeland security. The goal of the Mechanical Engineering and Homeland Security Doctoral Fellowship program is to provide

a foundation for solving critical national and global challenges in the maritime and homeland security domain through the use of state-of-the-art technologies and scientific approaches.

In contrast to Stevens Maritime Security Doctoral Fellowship, the Mechanical Engineering and Homeland Security Doctoral Fellowship functions as an interdisciplinary program, integrating course work from the Mechanical Engineering program with core courses from Stevens Maritime Security curriculum. The interdisciplinary fellowship combines the faculty resources and research assets of the two Stevens academic departments to provide a robust and multifaceted doctoral experience. The candidate awarded the Mechanical Engineering and Homeland Security Doctoral Fellowship may pursue doctoral research from a wide range of areas related to homeland security. Some of these include, but are not limited to:

- Advancing technologies for the detection and mitigation of maritime threats, including robotics and unmanned systems, e.g. Remotely-Operated and Unmanned Autonomous Vehicles (ROVs and UAVs).
- Techniques for exploring synergies among sensor technologies and platforms to improve the detection probability, minimize false alarms, and improve resource efficiency.
- Mathematical techniques for classifying threat types by analyzing their signatures, e.g., determining water-borne vessel categories using acoustic signatures.

The student awarded the Fellowship must complete the following program Course and Research requirements: 84 credits of graduate work in an approved program of study beyond the Bachelor's degree consisting of:

- A maximum of 30 credit hours obtained in an Engineering Master's degree Program.
- A program of study of 54 credits comprised of course work and research approved by the student's dissertation advisor and committee.
- Completion of Maritime Security Graduate Certificate core course requirements.
- Written and Oral Qualifying Examination.
- Dissertation Proposal Defense.
- Dissertation Defense.
- Dissertation.

Students applying for the Doctoral Fellowship must be U.S. Citizens. Admission to the Fellowship program will be made through a committee of Stevens Mechanical Engineering and Maritime Security faculty members and MSCs research PIs. The Fellowship admission review process will be based on a review of the candidate's scholastic record, professional accomplishments and fit between his/her research objectives and those of the Mechanical Engineering and Maritime Security faculty. The recipient of the Doctoral Fellowship award must have the potential to advance the state of the science in the field of Mechanical Engineering. As of June 30, 2015 MSC's director of education has conducted outreach to the Center's academic partners to identify high-potential candidates for the fellowship award. Admission preference will be given to candidates endorsed by MSC and

Stevens faculty. The Center has received input on qualified candidates and conferred the fellowship award during the fall 2015 semester.

Maritime Security Doctoral Fellowship - DHS Career Development 2013 Supplement Award

Alex Pollara, former DHS CDG Maritime Systems Master's Degree Fellowship student (2012 to 2014) was awarded the Maritime Security Doctoral Fellowship in June 2014. Alex's research in the area of passive acoustics recording systems has contributed to the Center's research in the area of mobile/modular maritime domain awareness and has inspired the development of two underwater recording systems. The two systems include the Passive Acoustic Recorder System (PARS), a small underwater hydrophone system, that is easily deployable and can be used to detect incursions in security zones, and the more advanced Stevens Passive Acoustic Recorder (SPAR), which models the compact size of the PARS, but with enhanced features for time stamping detections in real time, improved audio capabilities using a microcomputer and an array of four hydrophones, a rechargeable battery pack for extended operating time, and a magnetometer/accelerator used to locate the device and any movements that it might have made while deployed underwater.

This past summer, Alex played a key role in mentoring a team of four engineering students in the Center's 2015 SRI. The team included two undergraduate Mechanical Engineering students from Stevens Institute of Technology and two undergraduate students in Mathematics and Physical Oceanography and Electrical Engineering from the University of Puerto Rico-Mayaguez. The team's research project included building the Stevens Passive Acoustic Recorder system and fashioning it in a manner in which it can be incorporated into the Center's emerging research in MDA platforms. A copy of the team's final presentation slides entitled "Stevens Passive Acoustic Recorder (SPAR)" can be found on the MSC Summer Research Institute website at <http://www.stevens.edu/ses/SRI%202015>.

At the end of the summer research program, the students had an opportunity to test the deployment of the SPAR system in a joint acoustic experiment coordinated by Alex and a team of MSC researchers and Stevens faculty, co-hosted by the U.S. Merchant Marine Academy (USMMA) at Kings Point, NY. The USMMA experiment included two teams. The first team, the Remotely Operated Vehicle (ROV) team, coordinated by Dr. Brendan Englot, Stevens Mechanical Engineering department used an ROV to acoustically map the hull of the USMMA TV Kings Pointer. This technique enabled the determination of whether unauthorized devices might be affixed to a ship's hull. The data gathered from the experiment will allow the team to further develop their algorithms for robust 3D mapping with sparse and noisy data. The second team, the Passive Acoustics Signal Recorder team, including MSC researchers Drs. Alexander Sutin and Barry Bunin, together with Alex Pollara and students from the SRI Underwater Acoustics Team, deployed two passive acoustic configurations to study the application of passive acoustic methods for port protection. During the experiment, the SPAR system was tested and used to record data from its built-in accelerometer and magnetometer to monitor the systems orientation and stability throughout the experiment. Data collected from the acoustics-based experiment will be used as part of the MSC's research in MDA. Approval to conduct the joint

experiment at USMMA was granted by Capt. Lindman, Department of Marine Transportation, USMMA, and Mr. Tony Margan, MARAD School Ship Program Manager.

Since starting the doctoral fellowship in June 2014, Alex has completed 18 credits towards his doctoral degree and has engaged in the following courses and activities:

Semester	Course	Credit	Grade
Summer 2015	Research Mentor – Underwater Acoustic Systems Team – SRI 2015		
Spring 2015	OE 960: Research in Ocean Engineering*	3	S
Spring 2015	CPE 695: Applied Machine Learning	3	A
Spring 2015	BIA 656: Statistical Learning & Analytics	3	B
Fall 2014	EE 548: Digital Signal Processing	3	B
Fall 2014	OE 560: Fundamentals of Remote Sensing	3	A
Fall 2014	BIA 652: Multivariate Data Analysis	3	A-
Summer 2014	Research Mentor – Sensor Technologies Team – SRI 2014		

*Note: Credits earned in OE 960 do not receive weighted grades. “S” means that the students successfully registered and completed credits toward their research requirements.

Maritime Systems Master’s Degree Fellowships – Student Inclusion in MSC Research Activities

Stevens Institute of Technology with the support of MSC’s director of education has been awarded three DHS S&T Career Development Grants. These awards provide for full-tuition support and stipends for high achieving, homeland security career-motivated students pursuing a Master’s degree in Maritime Systems with a Graduate Certificate in Maritime Security. The research activities in the Master’s degree fellowship program are directly linked to the ongoing and evolving research conducted through the MSC. As part of the DHS CDG-funded program, the fellowship recipients are required to engage in multidisciplinary research-based projects in conjunction with MSC researchers in the SRI and in field-based internships with Homeland Security operators. The DHS CDG-funded students must also complete an in-depth research project in the form of a Master’s thesis at the culmination of their degree programs.

Since 2010, nine students have been awarded Maritime Systems Master’s Degree Fellowships from Stevens. Six out of the nine students have successfully completed the fellowship program and are currently employed in homeland security related positions or are pursuing homeland security-centric doctoral study. The latest student to join the Maritime Systems Fellowship program is Tyler Mackanin, a 2015 graduate of Stevens Institute’s Naval Engineering undergraduate degree program. Competitively selected by the Maritime Systems Fellowship review committee, Tyler began his fellowship program this past June, where he participated in the MSC SRI as a member of the Magello Emergency Response Team.

DHS CDG Master's Degree Fellows

In May 2015, **Chris Polacco** completed his degree requirements to receive the Master of Science in Maritime Systems and a Graduate Certificate in Maritime Security. Over the past year, Chris completed his remaining coursework and defended his Master's thesis titled "*A Technology-Based Approach to Security Exercises.*"

Chris's thesis was inspired by research he conducted during the 2014 Summer Research Institute, in which he and his team utilized the Center's maritime simulation software and developed maritime threat exercise manuals that could be used for emergency response training purposes. Chris's research and familiarity with the Center's NaviTrainer and NaviHarbor simulation software earned him a ten-week internship with the NYPD-Counterterrorism Division. Throughout his field-based internship, Chris provided training and support to NYPD-CTD officers and their partners on how to use the maritime simulation equipment to prepare for and respond to threats in the New York Harbor. Chris is currently being considered for employment at NYPD-CTD and will be submitting resumes to the FBI, Transas USA, and the NJ Office of Homeland Security and Preparedness, among other DHS component agencies in the NY/NJ regional area.

Nicholas Haliscak, a fellowship student funded through the Center's 2012 CDG award completed 18 credits towards his Master's degree program, and had the unique opportunity to engage in a ten-week summer internship with the U.S. Coast Guard Research and Development Center. During his internship, Nicholas participated in the Arctic Shield 2015 exercise held aboard the Coast Guard Cutter HEALY in the Arctic Ocean. Nicholas' internship responsibilities included collaboration with members of the 3D Printing Team, including a faculty member from the USCG Academy, who developed parts and replacement items real-time during the Arctic Shield operational exercises. At the end of his internship, Nicholas presented his work to MSC and Stevens faculty and provided a brief on his summer activities in a USCG Research and Development all-hands meeting. Nicholas is currently finishing work on his Master's thesis focused on unmanned systems and is on track to complete his Master's degree this fall at Stevens.

Hasan Shahid is the second student to have received a fellowship from the 2012 CDG award. He is an alumni of the Center's 2011 SRI and was competitively selected by the fellowship review committee to join the program in June 2014. During the 2014-2015 academic year, Hasan completed 18 credits towards his Master's degree requirements and presented research he conducted during the SRI 2014 program at the International Society for Optics and Photonics (SPIE) Defense and Security Conference held in April 2014. Hasan's work caught the interest of Dr. Charles Potter, Distinguished Member of the Technical Staff at Sandia, who later visited Stevens to learn more about the Center's work in the area of layered detection systems and to provide a seminar on his current work in the area of domain awareness for radiological and nuclear security. During the summer of 2015, Hasan engaged in a ten-week summer internship with the USCG Research and Development Center in New London, CT. During his internship, Hasan accompanied researchers from the RDC in the 2015 Arctic Shield experiments held aboard the USCGC HEALY in the Arctic Ocean. Hasan's internship assignments included data collection and hands-on support during an ROV performance evaluation and situational awareness

exercise. Hasan is currently enrolled in 9 credits of coursework and is conducting research towards his Master's thesis in the area of small boat detection and radar systems.

As mentioned above, **Tyler Mackanin** is the latest student to join the CDG 2012 fellowship award program. Highly endorsed by faculty members in the Stevens Naval Engineering program, Tyler was competitively selected by the fellowship review committee members to join the Maritime Systems fellowship program in June 2015. Over the past summer, Tyler engaged in the Center's 6th annual SRI as a member of the Magello Emergency Response team. Tyler is currently enrolled in three courses for a total of 9 credits towards his degree requirements and will pursue summer internship opportunities at the USCG RDC or another DHS component agency over the next few months. Table 7 below provides a summary of the DHS CDG-funded student activities as they pertain to MSC research and stakeholder activities during Year 1.

Table 7. Summary of DHS CDG Fellowship Student Activities & Stakeholder Engagement.

Student	Program Start	Background	MSC Research Activities and Stakeholder Engagement
Nicholas Haliscak	Jan. 2014 – expected graduation Dec. 2015	B.Eng in Mechanical Engineering, TAMU-Kingsville	USCG Research and Development Center – Summer Intern. -Participated in the USCG 2015 Arctic Shield aboard the USCGC HEALY in the Arctic Ocean. -Responsibilities included working with the 3D Printing Team. -Attended NUSTL/NYAST Seminar on Countering Unmanned Aerial Systems and the Undergraduate Research Symposium at Rutgers.
Tyler Mackanin	June 2015- expected graduation May 2017	B.Eng in Naval Engineering, Stevens Institute of Technology	Engaged in the MSC 2015 Summer Research Institute. -Conducted research on NOAA GNOME spill modeling capabilities for inclusion in Magello. -Participated in NYPD-CTD Maritime Simulator training.
Chris Polacco	Aug. 2013 – Aug. 2015	M.S. in Maritime Systems w/ a Graduate Certificate in Maritime Security	NYPD-Counterterrorism Division – Summer Intern. -Supported NYPD's training division to train NYPD personnel and port partners on the NaviTrainer and NaviHarbor

		B.Eng in Chemical Engineering from Stevens Institute of Technology, May 2013	<p>maritime simulation software.</p> <p>Defended Master's thesis entitled <i>A Technology-Based Approach to Security Exercises</i>.</p> <p>Attended NJ OHSP Annual Conference.</p>
Hasan Shahid	June 2014 – expected graduation May 2016	B.Eng. in Electrical Engineering, Stevens Institute of Technology	<p>USCG Research and Development Center Summer Intern.</p> <p>-Participated in 2015 Arctic Shield aboard the USCGC HEALY in the Arctic Ocean.</p> <p>-Engaged in data collection and ROV performance evaluation and situational awareness exercises.</p> <p>Presented <i>Technology integration and synergies: radar, optics, and AIS</i> research at SPIE Conference in Baltimore, MD.</p> <p>Attended NUSTL/NYAST Seminar on Countering Unmanned Aerial Systems, NJ OHSP Annual Conference and the NYPD-CTD Maritime Simulator training. Provided demos of the Center's broadband technology to visiting guests from Sandia National Labs, and local, state, and Federal agencies.</p>

DHS CDG Master's Degree Fellowship student engagement with MSC stakeholders

Over the past year, the CDG-funded fellowship students have regularly engaged in the Center's meetings and activities with stakeholders and have played key roles in the demonstration of the Center's passive acoustic, broadband radar and maritime simulator capabilities to visiting guests. The integration of the fellowship students in all aspects of the Center's research activities and meetings with stakeholders has contributed significantly to their professional development. The students are routinely asked to provide presentations and discuss their research with a range of industry and government professionals, thereby enhancing their communication skills, reinforcing their technical knowledge, and advancing their networking capabilities. The bulleted list below provides

an overview of some of the many activities and stakeholder meetings the fellowship students have participated in during Year 1 of the MSC.

- Area Maritime Security Committee – Members at Large Meeting – June 2015
- NYPD-Counterterrorism Division Maritime Simulator Training – May 2015
- Maritime Cyber Security Workshop – Rutgers University – March 2015
- Councilman Michael Russo – Center Tour & Brief – March 2015
- Council on Foreign Relations Military and Intelligence Fellows – Center Briefing & Tech Demos – January 2015
- Old Dominion University Sea Level Rise Committee Members – Center Briefing – December 2014
- Chile's National Commission for Scientific and Technological Research (CONICYT) – Dr. Werner Creixell Fuentes and Dr. Takeshi Asahi Visit – Center Briefing – November 2014
- NJ Office of Homeland Security and Preparedness Annual Conference – October 2014

3.4. MSI Outreach and Engagement in Research

During Year 1, MSC in conjunction with Stevens faculty members Dr. Jon Miller and Dr. Andrew Rella, Davidson Laboratory hosted Dr. Allison Fitzgerald, Assistant Professor of Biology and Ms. Kaylee Saltos, undergraduate Marine Biology from New Jersey City University in the DHS Summer Research Team Program for Minority Serving Institutions. Competitively selected by DHS OUP, Dr. Fitzgerald and Ms. Saltos engaged in research designed to investigate the effects of fouling organisms on water velocity underneath piers and port structures. The ten-week project included the use of oyster larvae on settlement plates attached to concrete pilings in the Raritan Bay in New Jersey (see Figures 7 and 8).



Figures 7 and 8. Dr. Allison Fitzgerald (center) and Ms. Kaylee Saltos (right), from New Jersey City University conducted research with Dr. Andrew Rella (left) Stevens Institute during the DHS Summer Research Team Program for Minority Serving Institutions.

The team's objectives were to study the impacts of oyster beds on the resilience of pier piling infrastructure during extreme weather events and increased water flows. At the end of the summer research project, the concrete pilings were placed into a wave tank at Stevens, where the 3D-structure of the pilings were tested for impacts. The team presented their research findings to MSC administrators and Stevens faculty and in a guest lecture during Dr. Jon Miller's OE 589 Coastal Engineering course.

As part of her undergraduate research experience, Ms. Saltos submitted a final report titled "*Colonization of Fouling Organisms on Different substrates As a Simulation to Changes in Water Flow around Fouled Pier Pilings.*" Ms. Saltos also plans to submit a research poster detailing her summer project for consideration at the New York Marine Sciences Consortium, to be held October 24, 2015 at SUNY Maritime College. Leading up to the selection of New Jersey City University SRTTP team members, the MSC director of education conducted outreach to the Center's academic partners and MSI contacts to identify potential SRTTP projects and collaborators. Targeted outreach included email exchanges with City Tech, Howard University, Johnson C. Smith University, Elisabeth City State University, University of Puerto Rico – Mayaguez, and Texas Southern University.

3.5. Professional Development Programs

During Year 1, the Center worked in conjunction with its academic partners from the Stephenson Disaster Management Institute (SDMI) at Louisiana State University to develop discussion-based tabletop exercises to enhance the preparedness and response capabilities of maritime security practitioners and port facility operators. SDMI and MSC administrators held routine monthly status update calls and collectively engaged in meetings with representatives from the USCG Sector New York, the New Jersey Office of Homeland Security and Preparedness, and NYPD – Counter Terrorism Division.

In recognition that tabletop exercises play a key component in the preparedness within the Port of New Orleans and ports nationwide, SDMI has begun the planning, design and development of the MSC **Maritime Incident Preparedness and Response Tabletop Exercise Series**. These exercises will provide Port officials and stakeholders with the opportunity to shape planning, assess and validate capabilities, and address areas for improvement. The SDMI planning team will utilize the planning efforts for the Port of New Orleans exercise series to serve as a framework for other ports to use to develop their own exercises. Prior to beginning the actual planning phase for the Port of New Orleans exercise, representatives from MSC and SDMI participated in meetings with officials from the USCG Sector New York, NYPD Counter Terrorism Division, and the New Jersey Office of Homeland Security and Preparedness. The purpose of the meetings were to help SDMI gather an understanding of port operations in New York/New Jersey, unique challenges facing the ports as well as solicit ideas and inputs on potential exercise scenarios that would be applicable to both inland and coastal ports. Through this collaboration, scenarios involved around active shooter and cyber security were recommended for further development.

Through the initiation of the Port of New Orleans exercise, SDMI has also begun a dialogue with the USCG Sector New Orleans to leverage the planned cyber exercise tabletop into a more comprehensive exercise for the USCG in late 2016. SDMI and the USCG are looking at integrating SDMI's Joint Training Cyber Lab as a component of a future exercise that will allow USCG, port officials and private industry members to respond to a cyber attack in a closed environment. Through the efforts of SDMI's participation in the Maritime Security Center, SDMI is introducing USCG New Orleans Sector personnel to a national cyber event. SDMI and USCG personnel participated in the Cyber Shield Initial Planning Conference in Salt Lake City, Utah for a nationwide Cyber Shield exercise in 2016. Cyber Shield is sponsored by the National Guard Bureau and involves multiple red versus blue team scenarios for a week-long cyber exercise.

Through the education and professional development component of the MSC, SDMI and Stevens have also begun a dialogue with the Port of New York/New Jersey to develop an additional cyber exercise in parallel to the New Orleans exercise. Commonalities in the ports will be explored to facilitate the development of a scenario that is applicable to both ports and can ultimately be used as a basis for other ports to develop their own cyber scenarios. Next, a status on the development of the Port of New Orleans Exercise is presented.

Through the two exercises currently in development, the Port of New Orleans will test and validate plans and capabilities, and identify both capability gaps and areas for improvement within its systems. Through scenario driven seminar and tabletop formats, SDMI will provide the port and its stakeholders a low-risk environment to test capabilities, familiarize personnel with roles and responsibilities, and foster meaningful interaction and communication across organizations. SDMI and the Port of New Orleans are well into the design and development and have held two on site planning meetings with port officials. Through these planning meetings, the following steps have been completed or are in progress:

- Exercise Design Team– The team has been selected and will remain small as to keep the exercise details to the design team only. This will ensure a more realistic and engaging exercise for participants. Representatives include SDMI Exercise Staff, Port of New Orleans Director of Operations, Port of New Orleans Harbor Police Department, Port of New Orleans Security and USCG Sector New Orleans.
- Exercise Foundation Established – selection of scenarios, discussion of exercise format, review of emergency plans and operations. The planning team agreed to keep actual exercises to a half-day format.
- Development of exercise-specific objectives and identifying core capabilities is in progress, based on the guidance of Port Officials.
- Exercise Logistics – The port is currently identifying suitable rooms within their facility to conduct the exercise. Final decision on specific location will take place at the next planning meeting.
- Development of exercise scenario – The port has selected Active Shooter as their first priority and Cyber Attack as their second priority.
 - Active Shooter – The event will be centered around an incident involving the cruise ship terminal and passengers on a departure or return day.

- Cyber Event – This scenario will involve the attack on a system/location along the Mississippi river in close proximity to the port. The attack will directly affect all vessel traffic and port operations.
- Exercise Participants Selected – The port and SDMI have initially identified the following agencies as participants. This list is not final, where additional participants may be added as we continue to work with the Port on the design.
 - US Coast Guard
 - Customs and Border Patrol
 - New Orleans Police Department
 - Federal Bureau of Investigations
 - EMS
 - New Orleans Fire Department
 - New Orleans OHSEP
 - Louisiana State Police Crisis Response/LSP Troop B/Fusion Center
 - DHS Protective Security Advisor
 - Louisiana Governor's Office of Homeland Security and Emergency Preparedness
 - Cruise Ship Representatives (Contract Security, Cruise Operations)
 - Port of New Orleans (Operations, Security, other key personnel)

3.6. Maritime Systems Seminar Series

The Center in collaboration with Stevens co-hosted several guest speakers in the Maritime Systems Seminar Series. The seminar series includes lectures by MSC and affiliate researchers and leading experts and practitioners in homeland security. The seminar series is designed to engage a broad audience of faculty, students, industry and government stakeholders, and the general public in relevant and timely topics in the maritime and homeland security domain. The seminar series is delivered on-campus at Stevens Institute. When possible the presentations were recorded and made available on the Seminar Series webpage at: <http://www.stevens.edu/ses/maritime-systems-seminar-series>. The seminars delivered during Year 1 are outlined in Table 8 below.

Table 8. Maritime Systems Seminar Series

Faculty/Guest Lecturer	Seminar	Date
Dr. Phillip Vital, Director of Ocean Engineering, Naval Engineering Facilities Command	<i>Security of Undersea Cabling</i>	06.18.2015
Mr. David Warrington, Port Authority of NY and NJ	<i>Risk Assessment and Risk Management in the Decision-making Process</i>	06.12.2015
Dr. Brendan Englot, Associate Professor, Stevens Institute	<i>ROVs in Maritime Security Applications</i>	06.11.2015
Mr. Chris Francis, Research Engineer, Stevens Institute of Technology	<i>Testing and Evaluating Layered Technologies for Harbor Security</i>	06.10.2015

Mr. Vivek Mitel, Axiom Research Labs and Sidney Nakao Nakuhoto, School of International and Public Affairs, Columbia University	<i>Team Indus - A moonstruck band of technology executors- aiming to land a spacecraft on the Moon</i>	03.24.2015
Dr. Margo Edwards, Senior Research Scientist, Hawaii Institute of Geophysics and Planetology	<i>Chemical Legacy: Techniques and Results of Deep-Water Sea-Disposed Munitions Assessment</i>	02.02.2015
Dr. Werner Creixell Fuentes and Dr. Takeshi Asahi, Chile's National Commission for Scientific and Technological Research (CONICYT) - Research exchange program.	<i>Identification of Maritime Activity using Satellite Imagery and Beacon Systems, and Automatic Object Detection on Images using Variational Tools</i>	12.02.2014

In addition to contributing to the Center's Seminar Series, several of the guest speakers have contributed to other aspects of the Center's research and educational program curriculum. For example, Mr. David Warrington and his colleagues from the Port Authority of New York and New Jersey have assisted Dr. Barry Bunin, Stevens Program Director Maritime Security in developing course content in the area of risk assessment and management for security applications, and have served as guest lecturers in Stevens Maritime Systems graduate-level courses.

Guest speakers Drs. Creixell Fuentes and Asahi have also engaged with the Maritime Security Center through the Center's participation in the international networking exchange program facilitated by Chile's National Commission for Scientific and Technological Research (CONICYT). Leveraging the COINICYT exchange program, MSC researchers have discussed opportunities to support and enhance Chile's Maritime Domain Awareness capabilities and to facilitate opportunities for student and faculty exchange in the Center's Summer Research Institute.

Available presentation slides and podcasts from the Maritime Systems Seminar series can be found on the MSC website at <http://www.stevens.edu/ses/maritime-systems-seminar-series>.

3.7. USCG Auxiliary University Programs at Stevens Institute of Technology

The Stevens USCG Auxiliary Detachment Unit is coordinated by MSC's director of education and by Dr. Hady Salloum, MSC Director. Over the past academic year, the Detachment Unit held regularly scheduled monthly meetings to discuss and engage in USCG Auxiliary training courses and to plan for field-based activities. Student training sessions included the following courses:

- Security Education and Training Awareness
- ICS100 – Introduction to ICS OnLine – FEMA-EMI
- IS-700 – Intro to National Incident Management System – FEMA-EMI

Members of the Stevens Auxiliary group also participated in meetings and events coordinated by the USCG Auxiliary in Lower Manhattan (see Figure 9). The Stevens

Detachment currently has six active Auxiliary members. Over the past year, five of the eleven original Stevens members either graduated or left employment at Stevens Institute. Efforts to recruit new members are ongoing and have included outreach at Stevens annual student Club Fair and plans have been discussed for a pizza party information session during the Fall 2015 semester. Over the past academic year, Stevens USCG Auxiliary administrators were also contacted by a faculty member at John Jay College of Criminal Justice regarding a newly forming Auxiliary student group at their university. Stevens and John Jay administrators have agreed to collaborate and share information regarding relevant upcoming trainings and field-based opportunities for the two student groups.

Established in 2012, the Stevens USCG Auxiliary Detachment program is one of twelve university-based programs in the nation and is the only Auxiliary university program to be partnered with a DHS Center of Excellence.



Figure 9. Stevens USCG Auxiliary student leader, Samantha Adornati, pictured center right, joins Auxiliary members from the Lower Manhattan Flotilla, during a Memorial Day parade in City Island, NY.

3.8. Summary of Education Milestones

3.8.1. 2015 Summer Research Institute

MSC successfully delivered the sixth annual Summer Research Institute, from June 1 to July 24, 2015 on the campus of the Stevens Institute of Technology in Hoboken, NJ. Since the program's inception in 2010, 103 engineering and science students, representing 20 U.S. universities, including MSI and HBCU designated schools have engaged in the SRI. The SRI 2015 student participants completed team research reports, presentations and research posters. Student participants engaged in hands-on research projects in collaboration with the Center's researchers and industry and government stakeholders. Copies of the students final team presentations can be found on the Center's website at <http://www.stevens.edu/ses/SRI%202015/>

Over the past year, SRI student alumni have engaged in field-based internships with the National Urban Security Technology Laboratory and Sandia National Laboratories, and one student was awarded a Stevens Graduate Research Assistantship in Maritime Security to continue research he started in the summer research program.

During their internships at NUSTL, Nicholas Monzillo (SRI 2013) and Gina Salmins (SRI 2014) conducted market research on homeland security-related tools and technologies and prepared reports for publication for first responders. Working under the mentorship of Dr. Lawrence Ruth, Director, Systems Division, the students also developed and executed quality control procedures for personal radiation detectors and documented the experiences of responders engaged in operational experiments with emerging technologies. Dr. Ruth offered the following quote in praise of Nicholas and Gina's quality of work and contributions to the System Assessment and Validation for Emergency Responders (SAVER) Program.

"Nicholas Monzillo and Gina M. Salmins, undergraduates at Stevens Institute of Technology, were spring and summer interns, respectively, at the National Urban Security Technology Laboratory (NUSTL) in New York, NY. The interns participated in programs that provide technical support to first responders. They conducted market research and prepared reports for publication that will provide first responders with needed information about their technologies and equipment, developed and executed quality control procedures for personal radiation detectors used by responders, and documented the experiences of responders engaged in operational experiments with emerging technologies. The interns addressed real-world homeland security issues, developed their writing and communications skills, analyzed and devised solutions for a product testing program, and experienced working in a professional, technical environment. They were highly motivated, enthusiastic, and the quality of their work products was outstanding. The interns contributed significantly to our technical programs and were a valuable asset to NUSTL. We enjoyed having them." Dr. Lawrence Ruth, NUSTL.

In her summer internship at Sandia National Labs, Sarah Walsh (SRI 2014) assisted Mr. Robert Jeffers, Senior Member of the Technical Staff, to develop a new theoretical model that explains how cities evolve over long periods of time given external shocks and stresses. Impressed by her work, Sandia has extended Sarah's internship for one year and have encouraged her to apply for Sandia's Critical Skills Master's Program (CSMP).

During Year 1, MSC also conducted a survey to assess the impacts of the SRI on the education, career choices and employment of its program alumni for Years 2010 to 2014. 44% of the alumni respondents reported that they were currently employed fulltime in the workforce and 24% said that they were employed and attending college/graduate school simultaneously. Out of the students who reported employment in the workforce (fulltime and employed attending college/graduate school simultaneously), 50% reported that their occupation was homeland security/maritime security related.

3.8.2. Mechanical Engineering & Homeland Security Doctoral Fellowship

During the spring of 2015, the Center prepared a work plan in support of a Career Development Supplement to develop a new doctoral fellowship in Mechanical Engineering

and Homeland Security. Awarded in July 2015, MSC in conjunction with Stevens Institute of Technology faculty will make available a fully funded fellowship award for one student throughout a rigorous and comprehensive research-based doctoral program in mechanical engineering with a concentration in maritime and homeland security. The interdisciplinary doctoral fellowship combines faculty resources and research assets from two academic departments and is intended to broaden the research scope of the Center to include research in the areas of robotics and unmanned systems. The Center has conferred the new doctoral fellowship award during the fall 2015 academic semester.

3.8.3. Maritime Security Doctoral Fellowship

Leveraging funds from a DHS 2013 Career Supplement, the Center developed a Maritime Security Doctoral Fellowship. The fellowship was competitively awarded to Alex Pollara, a graduate of Stevens Maritime Systems Master's degree program and Naval Engineering undergraduate program. Over the past year, Alex has completed 18 credits towards his doctoral requirements and is preparing to take his qualifying exams. Alex served as a faculty mentor during the Center's 2015 SRI and led a team of four undergraduate engineering students to develop a low-cost, high-efficiency, multi-sensor underwater recording platform. The Stevens Passive Acoustic Recorder will be used to support the Center's emerging research in MDA.

3.8.4. Doctoral Research Assistantship

MSC supported Ms. Talmor Meir in a research assistantship position during Year 1 of the Center. Talmor successfully defended her dissertation titled "*Characterizing Atmospheric Processes in the Complex Urban-Coastal New York City Metropolitan Area*", in the spring of 2015 and received her doctoral degree in Ocean Engineering. See below for an abstract of Dr. Meir's dissertation:

Dr. Meir's dissertation abstract: *This research is on the investigation of urban-coastal environments and how these regions are impacted by unplanned environmental and man-made hazard events. Specifically the study considers air-sea-land interaction under the chronic stress of heatwaves and hazardous pollutant releases. It explores air-sea patterns and processes operating in coastal cities and how such dynamical mechanisms are simulated by various environmental models.*

The New York City metropolitan area is examined through characterization of its marine atmosphere structure and evolution, where air-sea interaction and urban influences are prominent. The work utilizes high-resolution (~1 km) air/sea meteorological predictions to characterize the interaction of NYC's urban heat island with sea breeze systems during extreme heat events. In addition, it couples the meteorological models with an atmospheric transport and dispersion prediction model for evaluating atmospheric contaminant transport patterns.

Through quantifying to what extent the atmosphere and ocean are spatially coupled, this work documents horizontal variations in thermal fluxes, vertical wind and atmospheric stability. It concludes by summarizing the capabilities and limitations of an integrated system of models on a local scale and how it can inform emergency response protocol.

Dr. Meir served as a faculty mentor during the 2015 SRI and is employed as an Actuarial Analyst at Verisk Analytics.

3.8.5. Maritime Systems Master's Degree Fellowship Program

During Year 1 of the MSC, one student successfully completed the CDG Master's Degree Fellowship program to receive his Master's degree in Maritime Systems with a Graduate Certificate in Maritime Security and completed a field-based internship with the NYPD-Counterterrorism Division. He is currently pursuing employment opportunities within the NYPD, FBI, and the NJ Office of Homeland Security and Preparedness. One new student, Tyler Mackanin was competitively selected to receive the remaining seat in the Maritime Systems Master's Degree Fellowship Program. During the summer of 2015, Tyler participated in the MSC Summer Research Institute and conducted research to enhance the Center's Magello Emergency Response Tool. DHS CDG Fellows Nicholas Haliscak and Hasan Shahid, each completed coursework towards their Master's degree requirements and participated in ten-week field-based internships with the USCG Research and Development Center. As part of their internship responsibilities, the students engaged in the 2015 Arctic Shield experiments aboard the USCGC HEALY in the Arctic Ocean.

3.8.6. MSI Outreach and Engagement in Research

During Year 1, MSC in conjunction with Stevens faculty members Dr. Jon Miller and Dr. Andrew Rella, Davidson Laboratory hosted Dr. Allison Fitzgerald, Assistant Professor of Biology and Ms. Kaylee Saltos, undergraduate Marine Biology from New Jersey City University in the DHS Summer Research Team Program (SRTP) for Minority Serving Institutions. The MSI SRTP team members engaged in research designed to investigate the effects of fouling organisms on water velocity underneath piers and port structures. The ten-week project included the use of oyster larvae on settlement plates attached to concrete pilings in the Raritan Bay in New Jersey. The team's objectives were to study the impacts of oyster beds on the resilience of pier piling infrastructure during extreme weather events and increased water flows. At the end of the summer research project, Dr. Fitzpatrick and Ms. Saltos presented their research outcomes to MSC administrators and Stevens faculty members and Dr. Fitzpatrick provided a guest lecture and presentation to Stevens OE 589 Coastal Engineering students.

3.8.7. Professional Development Programs

During Year 1, the Center worked in conjunction with its academic partners from the Stephenson Disaster Management Institute (SDMI) at Louisiana State University (LSU) to develop tabletop exercises to enhance the preparedness and response capabilities of maritime security practitioners and port facility operators. SDMI and MSC administrators held routine monthly status update calls and collectively engaged in meetings with representatives from the USCG Sector New York, the New Jersey Office of Homeland Security and Preparedness and NYPD – Counter Terrorism Division. Taking a lead role in the development of the exercise series, SDMI has set into motion planning efforts with the

Port of New Orleans and USCG Sector New Orleans to pilot two discussion-based tabletop exercises in the spring of 2016, at the Port of New Orleans. The exercise scenarios include an active shooter event and a separate cyber security attack at a port facility. LSU was provided funding through the MSC Education budget. Budget expenses have included LSU/SDMI travel to and from meetings with the USCG and Port Officials at the Port of New Orleans, Table Top Exercise curriculum development costs and travel to Stevens to meet with the MSC administrators, as well as meetings with NYPD-CTD and NJ OHSP.

3.8.8. Maritime Security Seminar Series

MSC successfully engaged students and members of the Stevens community in maritime security-centric seminars. The seminars covered a range of homeland security and maritime security focused topics, intended to bring greater awareness to the importance of the maritime domain to the nation's safety and security. A list of the Seminar speakers and copies of their presentations slides where applicable, are available on the Center's website at <http://www.stevens.edu/ses/maritime-systems-seminar-series>

3.8.9. USCG Auxiliary Program

Over the past year, Stevens USCG Auxiliary Detachment program held regularly scheduled monthly meetings and engaged in activities in conjunction with the Lower Manhattan Flotilla. Student membership declined due to graduating student members and employees leaving the university. Efforts to recruit new members are ongoing and have included participation in Stevens annual club fair.

4. Other Related Activities

This section briefly describes projects that are not part of the cooperative agreement but are related to MSC activities. These include M3DA (Mobile/Modular Maritime Domain Awareness), Maritime Risk Symposium, outreach activities, and Management and Committee meetings.

4.1. Mobile/Modular Maritime Domain Awareness Project

The goal of this project is to first understand the M3DA capability needs based on the range of missions and the various scenarios in which the USCG and DHS components would utilize such a system. In parallel, this will allow the cataloging, at a high degree of fidelity, the full range of existing MDA sensor and sensor platform capabilities, with a view to identifying and demonstrating the most promising sensor packages and platforms of relevance to the identified M3DA capability needs. This project will address answering the following questions:

- What are the priority DHS applications that could benefit from a M3DA capability?
- What are the qualitative and quantitative performance requirements?
- What existing or near-ready technologies are available?

- What are the relevant regional operational scenarios?
- What combination of technologies and CONOPS demonstrate the greatest DHS/Coast Guard ROI?

This project was not awarded until Year 2 and reporting will be provided in our next annual report. However, there were activities that were conducted by Stevens that are related to this project as discussed next.

A Remotely Operated Vehicle (ROV) was deployed to acoustically map the hull of the US Merchant Marine Academy (USMMA) Training Vessel *Kings Pointer* at the USMMA in Kings Point, NY. This research will enable the determination of whether unwanted devices might be affixed to a ship's hull. The data gathered will allow the team to further develop their algorithms for robust 3D mapping with sparse and noisy data. The passive underwater acoustics detection system developed during the Summer Research Institute was deployed at the USMMA. Acoustic signals from passing vessels were recorded for detection, position, and characterization analysis. Also tested were the magnetometer and accelerometer capabilities of this new system. It was found that these latter capabilities worked well, and it was determined that the system did not move once it was placed in the water. The analysis of the acoustic data is underway.

4.2. Maritime Risk Symposium

Stevens will host the Maritime Risk Symposium on November 16 and 17, 2015 at the Stevens campus in Hoboken, NJ. This event draws together other Centers of Excellence, the U.S. Coast Guard, various academic participants, DHS components, DoD and industry. One of its objectives is to define and refine research questions/gaps in the maritime domain where COEs can consider focusing research and transition efforts. The theme of the 2015 Maritime Risk Symposium is "Maritime Risk in the Western Hemisphere and Southern Border Approaches." Our plan is to involve additional operational elements such as JIATF-S, CBP, and the new JTF-East and West as participants in the Symposium.

During Year 1, there were many activities that were performed to organize this event. For example, there were numerous meetings during the program year and outreach to speakers and moderators, engagement with USCG personnel at various organizations and various levels. The contacts that the Center has with the USCG Headquarters, various USCG Districts and Sectors, JIATF-South, JTF-East, ODNI, US Navy, National Labs, MARAD, the Port Authority of New York and New Jersey, maritime industry, and academia were leveraged.

4.3. Outreach Activities

MSC continued to host visitors and partner with various key organizations. As an example, on August 25, 2015, CAPT Michael Day, the newly appointed Commander of U.S. Coast Guard Sector New York and Captain of the Port of New York/New Jersey, visited Stevens to learn about the Center's research in Maritime and Port Security applications. MSC has partnered with the RDC, Customs and Border Protection, National Urban Security Technology Lab, the NYC Police Department, NY Office of Emergency

Management, NJ Office of Homeland Security and Preparedness, and others as described below.

USCG RDC

- MSC administrators joined the RDC leadership for meetings with USCG District 7 and Sector Miami (in January 2015).
- MSC and USCG RDC partnered to plan and co-host the 2015 Maritime Risk Symposium.
- MSC completed Port Resilience Decision Framework, Data Flows and Critical Systems study for RDC.
- MSC Master's Degree Fellows engaged in ten-week internships at RDC in New London, CT and engage in experiments as part of the 2015 Arctic Shield exercises aboard the USCGC HEALY.

NUSTL

- Student and faculty participated in the DHS NUSTL Countering Unmanned Aerial Systems Seminar held March 26, 2015.
- MSC SRI alumni students were placed in spring and summer internships at NUSTL.
- NUSTL representative participated in and attended the 2014 SRI student team final presentations event.

CBP

- CBP Officers hosted SRI 2014 and SRI 2015 students for a tour of CBP Operational Facilities at Port New York/Newark.
- CBP Officers discussed research ideas and projects with MSC administrators and students.

NYPD-Counter Terrorism Division

- MSC students and researchers engaged in Maritime Simulator training hosted by NYPD-CTD.
- NYPD-CTD, MSC and LSU met to discuss scenarios for discussion-based tabletop exercises.
- NYPD-CTD hosted MSC Master's Degree Fellow for a 10-week internship.

NJ OHSP

- MSC administrators and student participated in Emerging Issues in the Homeland Enterprise, NJ OHSP annual meeting October 2014.
- NJ OHSP met with MSC and LSU to provide input and discuss the Center's plans to develop discussion-based tabletop exercises.
- NJ OHSP and Stevens Cybersecurity department collaborated on Cybersecurity project.

NYC OEM

- OEM met with MSC SRI students to review and provide feedback on the Center's Magello.

MSC hosted Military and Intelligence Fellows from the Council on Foreign Relations for a briefing on the Center's research. Captain Pat DeQuattro (USCG), Colonel Samuel C. Hinote (Air Force), Colonel Stephen E. Liszewski (US Marine Corps), Deborah A. McDonald (National Geospatial Intelligence Agency), Captain Robert A. Newson (US Navy) and Colonel Michael W. Rauhut (US Army) visited the Center to discuss the Center's research and MDA tool capabilities. The Center also hosted senior managers from Sandia National Labs. The purpose of the visit was to discuss the Center research and areas of potential collaboration as they relate to maritime security and resilience.

4.4. Management Activities

The main COE management activities are discussed in this section. Early on, the Center organized key researchers and partners to participate in a kickoff meeting/workshop at the USCG Headquarters in Washington, DC. The Center leadership worked with the COE's Principal Investigators to develop project work plans and discussed project content that will benefit DHS and its stakeholders.

About three months after the kickoff workshop, a pre-workplan meeting was held on December 16, 2014 at Stevens in Hoboken. This meeting was attended by the USCG RDC management and experts, DHS S&T's Borders and Maritime Security Division, the DHS S&T Program Manager, and representatives from the Center (Stevens Institute, University of Miami, MIT, and University of Connecticut). The main objective of this meeting was to layout expectations for defining progress and understanding objectives to develop research projects milestones and metrics and discuss them among the Center leads and their counterparts from DHS and the RDC. The output of this meeting was used in refining the scope of the Satellite Surveillance, M3DA, and resilience projects. The COE management continued to work with the USCG to develop the port resiliency tool project.

Among other management activities, the COE responded to a conflict of interest that arose during discussions with the University of Connecticut's contracting office, which led to their request to withdraw from the program. During the reporting period, Dr Hady Salloum was appointed the MSC Executive Director, which became effective June 1, 2015.

4.5. Center Guidelines and Policies

During Year 1 MSC administrators created a document for the Center's academic partners and research PIs containing general orientation information (e.g. partner contact information, reporting requirements, and DHS acknowledgement and disclaimer statements), and copies of the Center's policy and security requirements for handling sensitive material, as well as student safety and security guidelines. The MSC General Information and Guidelines for Academic Partners document was shared with each of the

MSC partner schools, with the requirement that they acknowledge receipt and confirm that they have reviewed and understand the policy and security requirements for handling sensitive material and the student safety and security guidelines.

5. Next Steps

As most projects started in Year 2, we expect that all projects will achieve their intended objectives and be reported in our next annual report. We also expect to be issuing the RFP during Year 2 to solicit proposals for addressing the questions that result from the Maritime Risk Symposium.

Appendix 1 – SRI 201 Student Survey Instrument



Maritime Security Center SRI 2015 Student Survey

1. Student Survey

This survey is designed to document the SRI's impacts on your knowledge and understanding of the Marine Transportation System, Maritime Domain Awareness and the challenges faced by the DHS and maritime security practitioners in securing our nation's ports and coastal borders. We also want to assess the quality of the SRI from your perspective.

Please take the time to provide us with as much detailed information as possible in the open-ended questions of this survey.

We thank you for your time and feedback!

* 1. How would you describe your knowledge of the maritime domain prior to the start of the SRI?

- ☐ 1=No prior knowledge
- ☐ 2=Minimal knowledge
- ☐ 3=Working knowledge
- ☐ 4=Advanced knowledge

* 2. How would you describe your knowledge of maritime security tools and technologies prior to the SRI?

- ☐ 1=No prior knowledge
- ☐ 2=Minimal knowledge
- ☐ 3=Working knowledge
- ☐ 4=Advanced knowledge

* 3. How has your knowledge of your assigned research area (e.g., Underwater Acoustics, Sensor Integration, and Situational Awareness/Magello Emergency Response) improved over the course of the eight-week summer research program?

		2=Improved (I have a basic understanding of the concepts.)	3=Improved Sufficiently (I can effectively apply my knowledge.)	4=Improved Substantially (I have gained advanced knowledge and confidence in this area.)
Knowledge of research project area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 4. To what extent has the SRI enhanced or improved your skills in the following areas?

	1=Not at all	2=Somewhat (Very little improvement in this area.)	3=Improved Sufficiently (My skills have improved and I can effectively apply what I have learned.)	4=Significantly Improved (I have significantly improved my skills and I feel confident in my capabilities in this area.)
Ability to Conduct Research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communication Skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leadership Skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Networking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Oral Presentations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Professional Confidence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teamwork/Collaboration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Writing Skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify)

* 5. In your opinion which of the skills above did you improve the most and what activities in the SRI helped you improve these skills?

6. What skills would you have liked to improve more? (e.g. writing, networking, etc.)

* 7. Rate the SRI with regards to the following items:

	1= Not good at all	2= Good	3= Very Good	4= Excellent
Quality of Program Coordination/Administration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Faculty Mentor Guidance and Assistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of the Program Curriculum	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of Faculty Lectures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of Guest Lectures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of Teamwork	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of Field Trips	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of Research Facilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of Research Outcomes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to be Innovative and Self Motivated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 8. What are your top 3 takeaways from this summer's program? (We would like to quote your responses, so please provide as much detail as possible.)

* 9. What would you say are the strengths of the SRI? (e.g. Administration, faculty interaction/collaboration, student team work/collaboration, meetings with stakeholders, research assets, field visits, field experiments, networking opportunities, etc.) Please provide as much detail as possible.)

* 10. What can the Maritime Security Center do to improve the Summer Research Institute for future student groups? (Please provide as much detail as possible.)

* 11. How would you best describe your experience in the SRI?

* 12. What topics, lectures, and/or field visits did you find most interesting and engaging?

* 13. Has the SRI enhanced your interest in pursuing a career and/or further academic study in the field of maritime/homeland security?

☐ Yes

☐ No

* 14. Would you recommend the SRI to your friends and colleagues at your university/school?

☐ Yes

☐ No