Texas Southern University

Department of Homeland Security Scientific Leadership Award Program

DHS-15-ST-062-001

Preparing Technically Savvy Homeland Security Professionals for Maritime Transportation Security

AWARD NUMBER: 2014-ST-062-000057-02

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1 EXECUTIVE SUMMARY

Texas Southern University's DHS SLA program was launched in September 2014. It is a five-year program aims to increase the Pipeline of Science, Technology, Engineering, and Mathematics (STEM) majors in MSI for Maritime Transportation Security through interdisciplinary Undergraduate Research and Education.

To achieve this goal, this program has three specific objectives, which are: 1) Develop an integrated research and education program to provide innovative technology solutions for the Homeland Security Enterprise (HSE), particularly for maritime transportation security. 2) Develop an interdisciplinary undergraduate curriculum to prepare a technically savvy workforce in Maritime Transportation Security.3) Increase the number and quality of students who graduate in a STEM discipline within Minority Serving Institutions (MSI).

These three objectives will be achieved in two phases. FY2017 is the first year of second phase, and the following are some highlights of our progress made in FY2017:

- A consortium of TSU and other four universities was awarded "***Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)***" by U.S. Department of Transportation. CAMMSE, as a Tier 1 University Transportation Center, will address the FAST Act research priority area of "Improving Mobility of People and Goods" by focusing on developing advanced technology, methods and models for multimodal transportation (including highway, air, rail, freight, public transit, bicycle and pedestrian) as well as educating and developing an effective workforce. Dr. Yi Qi serves as CAMMSE's Associate Director at TSU.
- During last year, TSU continue collaborating with a DHS Center of Excellence, Maritime Security Center of Excellence (MSC) at Stevens Institute of Technology (SIT).
- We started a new collaboration with Dr. Liang- Cheng and Dr. Yupeng Zhang at University of Houston. Dr. Yupeng Zhang has developed a presentation on "***Cybersecurity Foundation and Awareness in Maritime***" for the DHS SLA program workshop in the future.
- We started a new collaboration with Dr. Manhar Dhanak and Dr. Alka Sapat at Florida Atlantic University. Dr. Yi Qi presented her research work in a workshop on Enhancing Resiliency of Maritime Ports hosted by Florida Atlantic University. . In July 2017, Dr. Qi provided assistance to Dr. Alka Sapat on conducting a survey to the executives at Port of Houston for a research project on port resiliency.
- New course "***Maritime Risk Assessment and Resiliency Analysis***" developed by Capt. Morgan received approval from the University Curriculum Committee for a new online 15-weeks course for the Fall2018 semester.
- Program supported students made great progress on their study and research and multiple honors have been awarded to our students. Program supported student Tyrie Goodman

was offered an internship position by Federal Highway Administration during summer 2017. He was reported as a student star by TSU.

- Program involved faculty members have been very productive in last year and **10** papers have been accepted for published in peer reviewed journal and another **6** papers have been submitted for publication. **All** faculty members were invited to present their research on various meeting, seminars or workshops.
- For program outreach and recruiting student purposes, we successfully hosted the 2017 **Summer Maritime Academy** to high school students in Houston, and collaborate with Elkins High School on 2017 **Summer Internship Program.**
- Our program continued providing learning and networking opportunities to Maritime undergraduate students by organizing numerous events and encouraging students to participate program related off-campus activates.

This report presents the program progress and achievements we made during FY 2017 (from September 2016 to August 2017). It consists of following nine parts: maritime curriculum development, research progress, collaborations with COE partners, other collaborations, maritime events and activities, program achievements, supported students report, program management and challenges.

2 COURSE DEVELOPMENTS

Developing an interdisciplinary maritime undergraduate curriculum is one important objective of TSU DHS SLA program. As proposed, this objective would be the focus of Phase 1, and will be continually worked on through Phase 2. By the end of this program, 5 new interdisciplinary courses will be developed, including:

- New course 1: Software for Scientific Computing (online),
- New course 2: Introduction to Operations Research (online),
- New course 3: Introduction to Maritime Cybersecurity,
- New course 4: Maritime Big Data Analytics and Security,
- New course 5: Maritime risk assessment and resiliency analysis.

Besides new developed courses, 4 existing security-related courses for maritime program will be updated, including:

- MTMS 341 - Maritime Security Management,
- MTMS 342 - Maritime Security Technology,
- MTMS 424 - Containerization and Modern Cargo Storage,
- MTMS 443 - Maritime Transportation Security.

By FY2017, new course 1, 2 and 5 have been developed, and our team will continue working on developing the other two courses. In addition, significant improvements have been made in two courses: MTMS 341 and MTMS 443. The following part provides updates of these newly developed or improved courses.

2.1 New Courses

Dr. Yunjiao Wang added more teaching materials to New Course 1 and New Course 2. A completed list of lecture videos was developed and are accessible to students.

In addition, new course 5 "*Maritime Risk Assessment and Resiliency Analysis*" developed by Capt. Morgan received approval from the University Curriculum Committee for a new online 15-weeks course for the Fall 2018 semester.

2.2 Improved Courses

In the year, two courses have been continuously improved by Dr. Mehdi Azimi, which were "MTMS 341 – Maritime Security Management" and "MTMS 443 – Maritime Transportation Security". For each session of the class, a lecture in the format of a PowerPoint presentation was designed and uploaded in the course blackboard. For some lectures, additional handouts from external sources were also selected and uploaded to help the students better understand the topics taught in those lectures. Furthermore, short videos related to some topics were selected to play at the end of the lectures. Moreover, related articles from magazines, publications, trade journals and newsletters within the technology industry are read and discussed with the students during the classes. The following figures are screenshots of MTMS 341 and MTMS 443 pages in the university blackboard, accessible to the students.
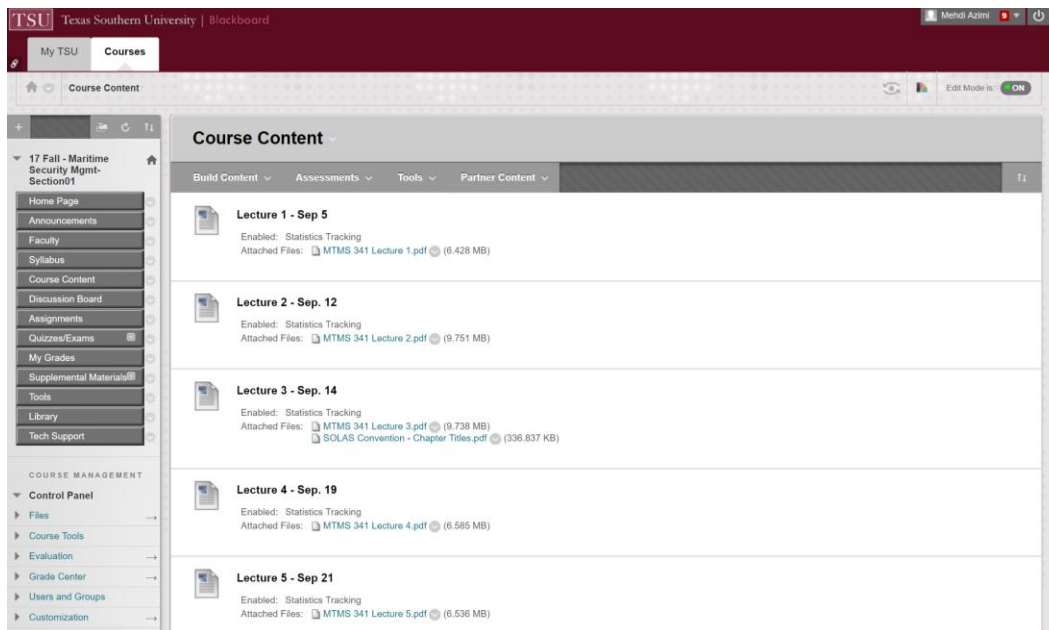
Figure 2-2. Maritime Security Management
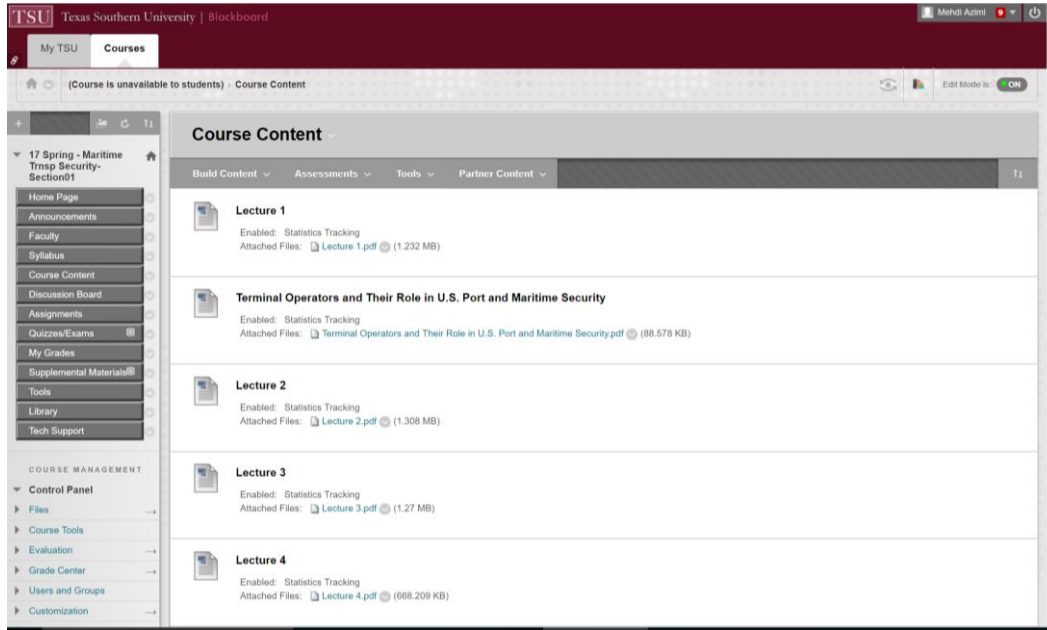
Figure 2-3. Maritime Transportation Security

2.3 Development of Seminars and Workshops

In FY2017, the TSU DHS SLA program continued to host a series of seminars on various topics of homeland security. Two seminars "Securing the Port of Houston Lecture" and "The Future of National Security – Maritime Cybersecurity" were organized and well received by students. These seminars not only expose students to knowledge outside their classroom, but also provide network opportunities with industry experts. In addition, a training event, "Fast Forward Workshop" was held on April 6th, 2017.

Figure 2-4 DHS SLA Seminar Flyers

Seminar 1: "Securing the Port of Houston Lecture" –11/16/2016

Figure 2-5 Ret. Capt. Woodring Presented at DHS SLA Seminar

TSU Department of Transportation Studies invited Ret. Capt. Woodring from Port of Houston to give a lecture to students. Captain Woodring retired from the U.S. Coast Guard as Captain of the Port for Houston-Galveston in 2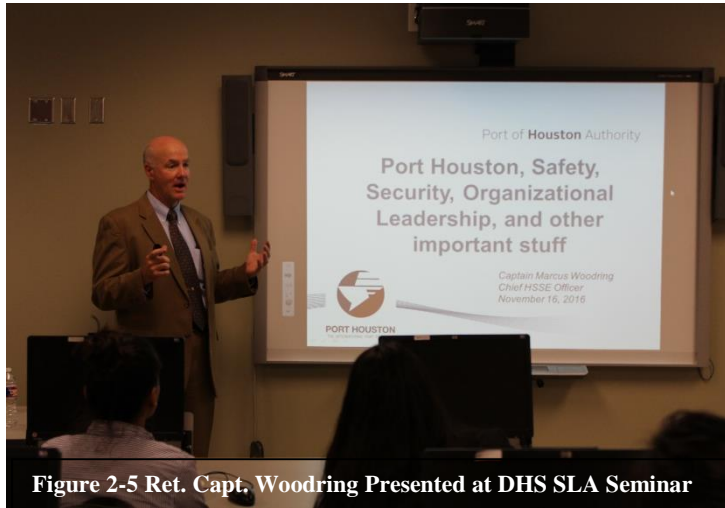011, and assumed his current position with the Port of Houston in July of that year. He is responsible for safety, security, and emergency response at eight terminals along the Houston Ship Channel, including bulk handling facilities at the Turning Basin, container terminals at Barbours Cut, Bayport, and the cruise terminal in Pasadena. Capt. Woodring's lecture was "Securing the Port of Houston". He stressed the importance of the field of Maritime and its economic impact on the City of Houston. This was a lecture reinforced the importance of their major and the difference that they can make by investing their careers in this field.

Figure 2-6 Students at Ret. Capt. Woodring's Lecture

Seminar 2: "The Future of National Security – Maritime Cybersecurity" – 04/17/2017

TSU Department of Transportation Studies invited Dr. Liang- Cheng and Dr. Yunpeng Zhang from university of Houston to give a lecture on the topic of "Maritime Cybersecurity" to our students. Dr. Zhang worked as a Cybersecurity and Software Engineering expert for more than 15 years where in this time span has invented more than 30 high performance/security new

algorithms/methods, and developed 8 software systems. In addition, he has published 49 papers in peer-reviewed journals and conference, and holds 6 patents. Dr. Cheng is an Associate Professor in the College of Technology at the University of Houston. His current research focus on supply chain risk management, inter-organizational information systems, alternative vehicle technologies, and strategic supply chain management. Dr. Cheng has conducted a stream of transportation projects funded by US and Texas DOTs as well as University of Houston. This endeavor has resulted in two GIS-based transportation simulation projects funded by FHWA of the US DOT for which he served as the Principal Investigator. The topic of their lecture was "The Future of National Security – Maritime Cybersecurity". They emphasized that the maritime transportation system is one of the most important critical infrastructure systems for US. The modern physical maritime system depends heavily on data & information exchanges of the cyber maritime communication system. The cyber spaces of the maritime communication system consist of extremely complex local/remote instruments, wireless sensors, networked facilities, large-scale storage, and sophisticated workforce. Since the industry rely heavily on technology, there has been evidence demonstrating that cyber-attacks can cause severe losses of assets or even lives in maritime transportation. Dr. Cheng and Dr. Zhang discussed the theories and practices of the overall cybersecurity and the current states of maritime cybersecurity with examples. They also touched on why the maritime cybersecurity is the future of national security. Towards the end of the lecture, Dr. Cheng and Dr. Zhang gave a demo to illustrate a network structure of a vessel and its weak points. The demo included a live example to show an encryption tool which could be implemented in the maritime communication.

Figure 2-7. Dr. Liang- Cheng and Dr. Yunpeng Zhang Discussed with TSU Faculty and Students

Training: "Fast Forward Workshop" – 04/6/2017

TSU Dept. of Transportation Studies offered students a one-day training event of "*Fast Forward Workshop*". Training topics included Effective Communication Strategies, Leadership 101, Conflict Resolution, and Dealing with Change. Maritime industry professionals were invited to share their experience with students. Mr. Baldwin, CEO of Baldwin Liaison Consulting spoke at length on conflict resolution which the students enjoyed. Dr. Bradford Director of Transformation and Innovation Center at Houston Community College spoke to the students on the importance of great communication skills in the workforce. And the Key Note Speaker Rod Hudson, of the U.S. Customs and Border Protection, talked about how to get a start in the work force, benefits of working with the Customs and Border Protection and how to prepare yourself for a career.

Figure 2-8. Faculty Students and Invited Speakers at Fast Forward Workshop

3 COLLABORATIONS WITH DHS CENTER OF EXCELLENCE (COE)

During last year, TSU continue collaborating with a DHS Center of Excellence, **Maritime Security Center of Excellence (MSC)** at **Stevens Institute of Technology (SIT)**, in following different aspects:

- We have contacted with Dr. Beth DeFares in MSC at SIT for our collaborating on the development of maritime cybersecurity curriculum. To enhance the knowledge, technical skills and research capabilities of our students, TSU is working on adding more Maritime

Cybersecurity contents to our existing maritime security classes and we are planning to send our faculty members to attend a summer workshop hosted by the MSC at SIT. In this work shop, the TSU faculty will review the new curriculum that faculty members in MSC at SIT have developed for a NSF funded Maritime Cybersecurity project and to discuss ways in which we can begin to introduce the course material into our maritime security classes.

- Under the support of MSC at SIT, TSU has developed and submitted a new proposal titled "Environmental and Maritime Disaster Management (EMDM) of the Port of Houston" for the 2016 DHS Scientific Leadership Award Program. The proposed program is to address DHS workforce shortage and diversity issues and broaden its current environmental and maritime training programs. Although this proposal has not been selected by DHS, this collaborative effort will lead us to more collaboration between the different departments at TSU and the MSC.

4 RESEARCH

In the past years, TSU DHS SLA program continued involving faculty members across different departments to conduct integrated research pertain to maritime transportation security. Based on interviews with security officers in Port of Houston Authority and the areas of expertise of early career faculty and other researchers at TSU, the following research activities have been identified as research projects:

1) Maritime Risk Assessment and Management
2) Maritime Cargo Security: Data Analysis and Intelligent Screening
3) Secure and Efficient Maritime Data Storage and Retrieval

The objective of Phase 1 is to identify research topics, which has been successfully completed. In addition, our faculty members in charge of each research topic have made detailed plans for each research projects. Together with their student assistants, they have started working on some tasks, and made certain progress. This chapter will introduce each research topic as well as the research progress we made during the last year.

4.1 Maritime Risk Assessment and Management

Since the last reporting period, we have made notable progress through extensive research in identifying various practices contributing to risk in both international and domestic maritime transportation trade. We constructed additional topics leading to the approval of an online Maritime Risk Assessment and Resiliency Analysis course. We are scheduled to teach the first online course in the Fall 2018 semester.

We completed the following tasks for updating the two existing Maritime Security courses and preparing the lessons for the new online course:

- Task 1: conducted the Literature search (completed in Phase I)
- Task 2: conducted the Literature review (completed in Phase I)

- Task 3: Synthesized the data obtained for identifying the methods and measurements for maritime risk assessment and management (completed in Phase II)
- Task 4: Synthesized the data obtained for analyzing the methods and measurements for maritime resiliency (completed in Phase II)

In addition to the extensive research, collaborations with various security agencies (i.e., Department of Homeland Security, U.S. Customs and Border Protection, U.S. Coast Guard, the Port of Houston Authority Health, Safety, Security & Emergency Department, and the Maritime Administration), current lessons based on best practices are in place for the following security initiatives:

- Identifying the various risk and methods of risk management associated with maritime trade
- Managing the exposure to risk in both international and domestic maritime transportation
- Evaluating the effects of risk on maritime and port security
- Evaluating the human elements of risk assessment and management
- Handling risk from the perspective of both importers and exporters
- Constructing strategies for handling any perceived or expected risk
- Vessel, terminal, and security plans including the International Ship and Port Facility Security (ISPS) Code, cyber-security
- Methods used in port resiliency planning

4.2 Maritime Cargo Security: Data Analysis and Intelligent Screening

In this stage of the research project, we focused on Task 2 "Conducting the Data Collection". It is important to select a set of indicative factors in order to determine the risks related to a cargo. Therefore, we conducted more literature reviews to collect the publicly available knowledge on the subject. After choosing a set of important related factors, we designed an online survey. The survey was an online questionnaire and was created based on the factors from literature, as well as other factors proposed by the research team. The goal of the survey is to have the feedback of professionals and practitioners, who are working in this area, on our candidate risk factors. We decided to use online resources such as LimeSurvey to conduct the survey. The selected practitioner would need a username and password to access the survey. The data from the completed surveys will be used to further refine our risk factor analysis in the next phases of the project.

Figure 4-1 Designed Online Survey

4.3 Secure and Efficient Maritime Data Storage and Retrieval

As the prices for cloud computing and storage become more affordable for businesses and individuals, the need for securing the integrity of cloud-stored data becomes critical. People are vulnerable to provide their private information to the servers whose sole purpose is to deliver this info to third parties. These servers look very similar to the original server of interest to these people. This way of obtaining private information through deceiving people is called phishing. These web sites are brought to the attention of the users through hidden links in emails or some web sites and once a user clicks on these links they are brought to the phishing web sites. Maritime applications are subject to similar attacks as these applications involve human operators who are vulnerable to these deceitful processes.

The method of phishing is not a straightforward attack to a server or an individual's computer since it involves deceitful steps. We need to develop a method which is able to distinguish an original web site from a phishing website without introducing noticeable delay. The existing methods for detection of phishing web sites have some limitations. In this research, we improve stochastic optimization algorithms and we are aiming to apply these improved algorithms to automatic detection of phishing web sites. Stochastic algorithms have crossover and mutation operations which help them successfully escape from local minima. As a result, they are capable of converging to a global minimum or to a more favorable local minimum than those obtained by the deterministic algorithms. We propose to improve the Random Lines (RL) algorithm, a population-based stochastic optimization algorithm, and then use this improved form for identifying the phishing websites. Further improvements can be achieved by using

dynamic crossover. The standard RL method uses a crossover constant which is fixed throughout the optimization task. In contrast to this, an RL algorithm with dynamic crossover constant varies crossover rate through the optimization process in order to find a global minimizer more efficiently and more reliably. In the next step, we plan to apply the improved RL algorithm to achieve better performance with machine learning algorithms such as neural networks and linear and quadratic discriminant analysis. As a result, these algorithms may produce higher accuracies of identifying phishing websites.

5 MARITIME PROGRAM EVENTS AND ACTIVITIES

In FY 2017, the department of Transportation Studies at TSU continued to provide learning and networking opportunities to Maritime undergraduate students by hosting several events and encouraging our students to participate various maritime security related conferences and events. In addition to the student development events, we also host events designed to attract high school students to our maritime undergraduate program, such as Summer Maritime Academy (SMA) and Summer Internship Program with Elkins High School Engineering Academy. This chapter listed some major events our faculty and students have participated in the past year, as well as our recruitment efforts.

5.1 Conferences and Field Trips

- *Conferences Students attended*

Breakbulk Education Day – September 2016

To support the growing need for education in the breakbulk industry, Breakbulk Events & Media established Breakbulk Education Day. At the Americas event, it is called Breakbulk Jerry Nagel Education Day in honor of the late Jerry Nagel, a Breakbulk Lifetime Achievement Award winner.

Breakbulk Jerry Nagel Education Day is hosted in collaboration with Exporters Competitive Maritime Council (ECMC) and consists of a full morning of informative sessions about the project cargo and breakbulk transportation industry and its challenges. Designed to introduce the project cargo and breakbulk industry to university students and to those starting their careers, Breakbulk Jerry Nagel Education Day offers informational sessions, technology demonstrations and case studies explained by leading industry executives. The afternoon offers a change of pace as ECMC members lead the students on tours of the exhibition floor. TSU students attended the events free of charge and had an opportunity to meet with potential employers in the Maritime industry.

Figure 5-1. Ms. Ursurla Williams (Second from Right, Front Row) and Capt. Morgan (First from Right, Second Row) with Students at 2016 Breakbulk Education Day

97th Transportation Research Board (TRB) Annual Conference – 01/8-12, 2017

Our faculty members and student research assistants attended the Transportation Research Board's 96th Annual Meeting in Washington, D.C. from Jan. 8 to 12, 2017. More than 13,000 transportation professionals from around the world attended the conference which covers all transportation areas, with more than 5,000 presentations in nearly 800 sessions and workshops, addressing topics of interest to policy makers, administrators, practitioners, researchers, and representatives of government, industry, and academic institutions. Our faculty members and students presented their research outcomes at the meeting. Following is Dr. Yi Qi presented her work.

Figure 5-2. Dr. Yi Qi Presented Her Research at 2017 TRB Annual Meeting

(TAG) Congressional Synergy Series – Energy & Transportation – 8/23/2017

TAG is a Transportation Advocacy Group where their mission is to obtain adequate funding for the southern region's transportation infrastructure. TAG serves the Houston region as a unifying transportation advocacy group and as the voice for better mobility at the local, state and federal levels. On August 23, 2017 TAG and the U.S. Chamber of Commerce had an intimate discussion with the regional congressional leaders on the synergy between energy and transportation. They discussed how they can better position the region to secure transportation funding and the approval of infrastructure projects that support the energy sector and enhance our globally competitive economy. Our program supported student Tyrie Goodman and other TSU Students attended this conversion and learned the valuable lesson of the importance of improving transportation infrastructure for the betterment of the country.

Figure 5-3. Program Supported Student Tyrie Goodman (left) with Congressman Al Green (right)

- *Field trips and visits*

PHA Boat Tour – October 2016

TSU Department of Transportation Studies organized a tour of the Houston Ship Channel on the Port Houston's *M/V Sam Houston*. While on the tour, TSU Maritime Alumnus Anthony Flenoy shared his experiences working as a Facilities Security/Access Management Agent at the Port Houston. In addition, students met with TSU Maritime Industry Advisory Board member and Managing Director of Health, Safety, Security, and Emergency Management at Port Houston, Capt. Marcus Woodring (Ret).

Figure 5-4. Ms. Ursurla Williams with Students at PHA Boat Tour

Visit to Gulf Stream Marine – March 2017

TSU Department of Transportation Studies organized MTMS students to visit Gulf Stream Marine on the Houston Ship Channel for a tour of its facilities. Gulf Stream Marine is a leader in cargo handling, stevedoring and terminal operations in the Gulf Coast region. Students enjoyed a private lunch with Chief Operating Officer Mitch Heiserman where they had an opportunity to ask questions about the operations and security at Gulf Stream Marine.

Figure 5-5. Chief Operating Officer Mitch Heiserman (Frist from Left, Second Row) and Ms. Ursurla Williams (First from Right, front Row) with TSU Students at Gulf Stream Marine

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Figure 5-6. Chief Operating Officer Mitch Heiserman Presented to TSU Students

Maritime & Logistics Youth Expo 2017

TSU Maritime students volunteered as Docents for the 4th Annual Port of Houston Maritime and Logistics Youth Expo. At the Expo, TSU students helped guide local high school students through the exhibits at the event. TSU students were also exposed to the exhibits and had direct contact with potential employers in the maritime industry in the Gulf Coast region. Potential employers in attendance included the Port of Houston Authority, U.S. Coast Guard, U.S. Army Corp of Engineers, Texas Parks and Wildlife, and the Houston Pilots.

Figure 5-7. Ms. Ursurla Williams with Students at Maritime & Logistics Youth Expo 2017

5.2 Recruitment Events

One important objective of TSU DHS SLA program is to *increase the number and quality of students who graduate in a STEM discipline within minority-serving institutions (MSI).* Therefore, recruiting more students into the HS-STEM field is a key aspect of this program. To

attract more students to the Maritime Program at TSU, the Department of Transportation Studies frequently visits local high schools during their college day and other occasions. In summer 2017, department of Transportation Studies at TSU hosted "Summer Maritime Academy" to high schools in Houston Area. Also, in cooperation with Elkins High School Engineering Academy, TSU department of Transportation Studies hosted the summer internship program for the second year.

Summer Maritime Academy 2017

Twenty area high school students attended the annual TSU Summer Maritime Academy. The week long non-residential program is designed to introduce students to the Maritime industry and careers in the industry. Students visited the U.S. Coast Guard facility and Ellington Field. The U.S. Customs and Border Protection visited the students on campus for a demonstration on screening techniques used by U.S. CBP personnel at airports and seaports.

Figure 5-8 Student Activities during SMA

2017 Summer Internship Program with Elkin High School Engineering Academy

Since summer 2015, Department of Transportation Studies at TSU started the Summer Internship Program with Elkins High School Engineering Academy. This program was designed to attract high school students to the Maritime Management and Security Program. In summer 2017, four students from Elkin High School were selected for this year's internship program. They were mentored by Dr. Yi Qi. Both students worked on research projects related to improving transportation mobility and safety. This two-week internship program offers high school students the opportunity to work with professors and graduate students in our research labs, enabling them to participate in various research projects and learn about many of the tools and software programs that were used for transportation research purpose.
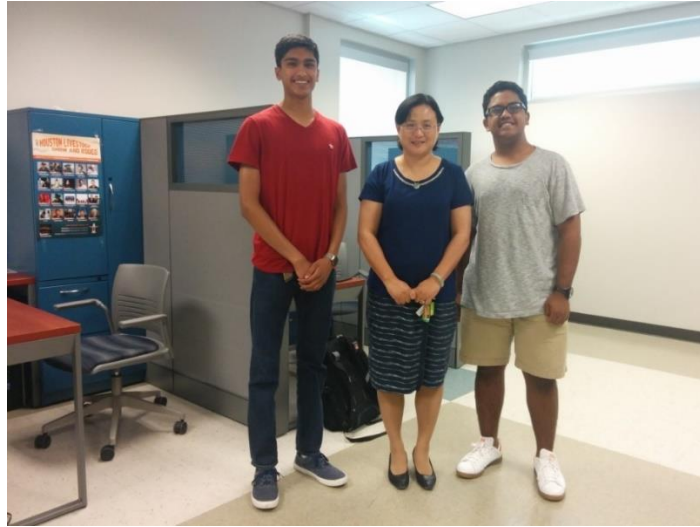
Figure 5-9 Dr. Yi Qi (middle) with High School Interns from Elkin High School

Figure 5-10 Dr. Yi Qi Supervised High School Intern in Her Research Lab

6 PROGRAM ACHIEVEMENTS

During the past year, program supported faculty researchers and students have made lots of achievements in term of their publications, presentations and grant awards. Many high-quality papers were developed by our faculty researchers and students. They also attended various meetings and workshops to present their research. Moreover, five new proposals led by Dr. Yi Qi and Dr. Mehdi Azimi have been submitted, and three projects were funded last year as a result of this DHS grant. This chapter summarizes all program achievements made during the past year.

6.1 Publications

Paper accepted for publication

1. Qi, Y and A. Guo, "Pedestrian Safety Under Permissive Left-Turn Signal Control", accepted for publication at International Journal of Transportation Science & Technology,2017

2. Qi, Y. and Q. Zhao, "Safety impacts of signalized lane merge control at highway work zones", Journal of Transportation Planning and Technology, Vol. 40, Issue 5, pp.577-591, 2017.

3. Kou, W., X. Chen, L. Yu, Y. Qi, and Y. Wang. "Urban Commuters' Valuation of Travel Time Reliability based on Stated Preference Survey: A Case Study of Beijing", Journal of Transportation Research Part A. Vol. 95: 372-380, 2017

4. Wang, Y., X. Chen, L. Yu, and Y. Qi. "Calibration of the Platoon Dispersion Model by Considering the Impact of the Percentage of Buses at Signalized Intersections", In Transportation Research Record: Journal of Transportation Research Board, No. 2647, DOI 10.3141/2647-11, Transportation Research Board of the National Academies, Washington, DC, 2017.

5. Teng, H., A. Puli and Y. Qi , "Identification of Influencing Factors of Graffiti Occurrence at Nevada State Highway Bridges and Soundwalls", Journal of Infrastructure Systems, Vol. 23 Issue 4 , 2017

6. **Y. Wang**, K. Chilakamarri, D. Kazakos and M. C. Leite. Relations between dynamics of network systems and their subnetwork systems. AIMS Mathematics, 2(3): 437-450.

7. **Y. Wang**, B. Omidiran, F. Kigwe and K. Chilakamarri. Relations between the conditions of admitting cycles in Boolean and ODE network systems, Involve, Vol.10, No.5, (2017), 813–831. DOI 10.2140/involve.2017.10.813 (B. Omidiran and F. Kigwe were two undergraduates).

8. **Y. Wang**, F. Davison and E. Bankole. Dynamics of a mathematical model for four-state binocular rivalry, Global Journal for Multidisciplinary Research, Vol.1, No.2, 2017. (F. Davidson and E. Bankole were undergraduates).

9. A. Jacot-Guillarmod, **Y. Wang**, C. Pedroza, H. Ogmen, Z. Kilpatrick, K. Josi ́c. Extending Levelt's Propositions to perceptual multistability involving interocular grouping. Cosyne Abstracts 2017, Salt Lake City USA.

10. A. Jacot-Guillarmod∗, **Y. Wang**∗, C. Pedroza, H. Ogmen, Z. Kilpatrick, K. Josi ́c. Extending Levelt's Propositions to perceptual multistability involving interocular grouping. Vision Research. Volume 133, April 2017, Pages 37-46. (∗ are co-first authors)

Paper submitted for publication

1. **Q. Zhao, T. Goodman** and **Y. Qi**, " Roadway Related Truck Crash Risk Analysis: Case Studies in Texas", submitted for presentation and publication in the proceedings of the 97th Annual Meeting of Transportation Research Board, Washington, DC, Jan 7-11, 2018, TRB 18-03220

2. **Azimi, M.,** I. Oyelade, A.M.Aremu, E. Balal, K. Cheu and **Y. Qi**, " Intelligent Transportation System Selection and Implementation for Work Zone Projects ", submitted for presentation and publication in the proceedings of the 97th Annual Meeting of Transportation Research Board , Washington, DC, Jan 7-11, 2018, TRB 18-03902

3. Sun, Q, Q. **Zhao**, T. Tao and **Y. Qi**, " Investigate the Safety Performance of Displaced Left Turn Intersections Case Studies in San Marcos, Texas", submitted for presentation and publication in the proceedings of the 97th Annual Meeting of Transportation Research Board, Washington, DC, Jan 7-11, 2018, TRB 18-06188

4. Tao, T, **Q. Zhao,** Q. Sun and **Y. Qi**, "Two-Way Left Turn Lane or Raised Median? A Large Truck Safety Based Study", submitted for presentation and publication in the proceedings of the 97th Annual Meeting of Transportation Research Board, Washington, DC, Jan 7-11, 2018, TRB 18-05892

5. Tanzila Rahman, **Q. Zhao** and **Y. Qi**, " Innovative Technology in An Emergency Response System for Reducing the Severity of Large Truck Crashes", submitted for presentation and publication in the proceedings of the 97th Annual Meeting of Transportation Research Board, Washington, DC, Jan 7-11, 2018, TRB 18-03292

6. Lan, L., L. Yu, **Y. Qi,** F. Qiao and **Azimi, M.**, " A Survey on state of Applications of Big Data in Transportation ", submitted for presentation and publication in the proceedings of the 97th Annual Meeting of Transportation Research Board, Washington, DC, Jan 7-11, 2018, TRB 18-02008

6.2 Seminar/Conference/Workshop Presentations

1. "Estimation of Design Lengths of Left-turn Lanes", Dr. Yi Qi, 2017 TRB
2. "Non-Intrusive Inspection (NII) Technologies for Inspection of Cargo at Ports of Entry", Dr. Yi Qi, Workshop on Enhancing Resiliency of Maritime Ports, at Florida Atlantic University, December 2016.
3. "Dilemma Zone Driving Behavioral Analysis at Signalized Intersections under Foggy Weather Condition with In-Vehicle Advance Warning Message", Dr. Mehdi Azimi, TRB, 2017
4. "Autonomous Vehicles: Impacts and Challenges", Dr. Yi Qi, CICTP2017, Shanghai, China
5. Ismet Sahin and Nuri Yilmazer, "Frequency Domain Time Delay Estimation with Optimization Over Randomly Selected Lines," GOC 2017, College Station, TX, March 2017

6.3 Funded Projects

1. PI: Dr. Yi Qi and Co-PI: Dr. Mehdi Azimi, Qun Zhao, "Determination of Freeway Acceleration Lane Length for Smooth and Safe Truck Merging", $57,642.31, CAMMSE Research Project

2. PI: Yi Qi and Co-PI: Dr. Dr. Mehdi Azimi, Qun Zhao, "Innovative countermeasures for reducing the truck waiting time at marine terminals", $57,709.01, CAMMSE Research Project

3. PI: Dr. Mehdi Azimi and Co-PI: Dr. Yi Qi, Qun Zhao, "Investigating the impact of different attributes on bicycling mode share as a multimodal connectivity strategy in large cities: A case study in Houston", $54,824.81, CAMMSE Research Project

6.4 Submitted proposal

Supported faculty researchers submitted five proposals to CAMMSE. Following are the proposals summited by our faculty members Dr. Yi Qi and Dr. Mehdi Azimi:

1. Determination of Freeway Acceleration Lane Length for Smooth and Safe Truck Merging
2. Innovative countermeasures for reducing the truck waiting time at marine terminals
3. Development of a Model for Inland Waterway Capacity Estimation
4. Investigating the impact of different attributes on bicycling mode share as a multimodal connectivity strategy in large cities: A case study in Houston
5. Analysis of Intermodal Vessel-to-Rail Connectivity: Port of Houston Case Study

6.5 Student Awards

The program support students have won various awards.

- Tyrie Goodman, Dwight D. Eisenhower Transportation Fellowship from FHWA, Jan 2017
- Tyrie Goodman, College of Science, Engineering and Technology (COSET) Scholarship, 2017
- Tyrie Goodman, College of Science, Engineering and Technology (COSET) Outstanding Student Ambassador, 2017
- McKenzie Jones, College of Science, Engineering and Technology (COSET) Dean's List Honoree, 2017
- McKenzie Jones, Housing Department Honors scholar, 2017
- Taylor Webber, College of Science, Engineering and Technology (COSET) Honoree, 2017
- Ester Martinez-Belmares, College of Science, Engineering and Technology (COSET) Outstanding Student Ambassador, 2017
- LaTerrian Perkins, Ronald B. Thorton Scholarship by TSU Ocean of Soul Alumni Association
- LaTerrian Perkins, Dwight D. Eisenhower Transportation Fellowship from FHWA, Jan 2017
- LaTerrian Perkins, College of Science, Engineering and Technology (COSET) Dean's List Honoree, 2017

- David Utae, TSU President List Award, 2017
- David Utae, Western Area Links Endowed Scholarship, 2017

6.6 Faculty Awards

- Capt. Morgan received the Certified in Transportation and Logistics (CTL) Certification from the American Production and Inventory Control Society (APICS) March 21, 2017 in addition to the same certification received from the American Society of Transportation and Logistics, received February 16, 2000
- Capt. Morgan completed the 36 hours course in Maritime Port Executive Management provided by the International Association of Maritime and Port Executives (IAMPE), in conjunction with the IAMPE and Loeb-Sullivan Graduate School of International Business and Logistics, at Maine Maritime Academy. Received the Maritime Port Executive (MPE) professional certification.

6.7 Others

Our program supported students Tyrie Goodman was offered an internship position by Federal Highway Administration in Tallahassee, FL where he worked as an environmental specialist intern for the division. He was reported as a student star by TSU.
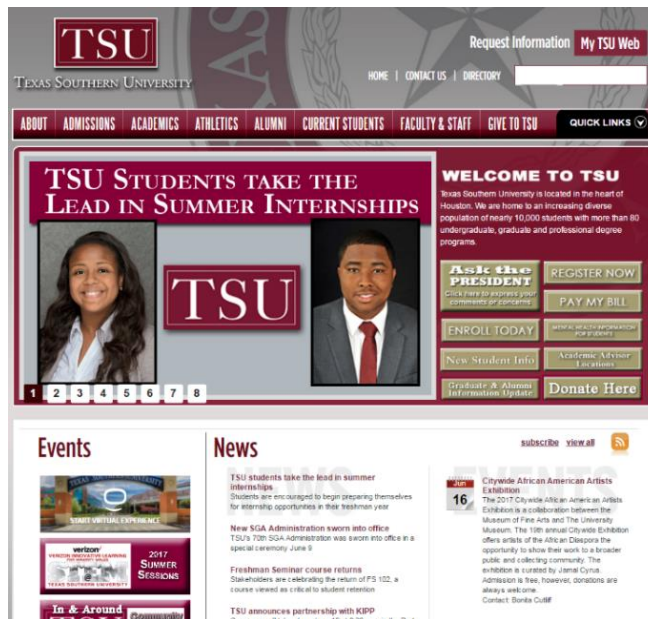

Figure 6-1. Screenshot of TSU FrontPage

7 REPORTS OF SUPPORTED STUDENTS

In FY 2017, one graduate student and five undergraduate students were recruited to participant in the DHS SLA program. The current students who are participating in the program are listed as below:

- Tyrie Goodman, Graduate student, Transportation Planning and Management

- David Utaegbulam, Undergraduate student, Chemistry

- Taylor Webber, Undergraduate student, Maritime Transportation Management and Security

- Ester Martinez-Belmares, Undergraduate student, Computer Science

- Laterrian Perkins, Undergraduate student, Maritime Transportation Management and Security

- McKenzie Jones, Undergraduate student, Maritime Transportation Management and Security

According to the program management requirement, each student submits a report per semester. The report is designed to collect their individual activities, including courses completed, GPA, internships completed, and career development activities. Following part lists the key information collected from each student.

7.1 Tyrie Goodman

Courses completed:

Fall 2016 Semester	*Spring 2017 Semester*
TMGT 842	Tran Project Implementation	TMGT 501	Grad Prof Writing
TMGT 882	GIS for Transportation	TMGT 850	Travel Demand Analysis
TMGT 899	Thesis	TMGT 899	Thesis

Cumulative GPA: 3.91

Internship Activities: (FHWA) Federal Highway Administration, Environmental Specialist

Career development activities:

- Transportation Research Board Conference 2017
- 2017 Offshore Technology Conference
- Fast Forward skills development workshop Texas Southern University
- TRB Webinar for Introducing Guidelines
- TSU DHS SLA Seminars
- Maritime & Logistics Youth Expo
- Congressional Synergy Series - Energy & Transportation

7.2 David Utaegbulam

Courses completed:

Fall 2016 Semester	*Spring 2017 Semester*
CS 117	Intro to Comp Science	CHEM 332	Quan Analysis Lab

ENG 231 | World Literature II	CHEM 332 | Quan Analysis Lec
MATH 243 | Calculus & Analytic Geo III	CHEM 445 | Biochemistry
PHYS 217 | Univers Phys Lab I	CHEM 445L | Biochemistry Lab
PHYS 251 | Univers Phys I	MATH 251 | Differential Equations
POL 236 | Texas Gov't	PHYS 218 | Univers Phys Lab II
	PHYS 252 | Univers Phys II

Cumulative GPA: 3.59

Internship Activities: JAMP (Joint Admission Medical Program) at Texas Children's Hospital

Career development activities:

- Undergraduate Research and Creative Activities Symposium (Honor College)
- Annual Medical Education Conference (AMEC)
- Fast Forward skills development workshop Texas Southern University
- TSU DHS SLA Seminars

7.3 Taylor Webber

Courses completed:

Fall 2016 Semester	*Spring 2017 Semester*
CS 116 | Intro to Computer Science I	ENG 132 | Freshman English II
ENG 131 | Freshman English I	GEOG 132 | World Regional Geography
MATH 130 | Fundamental Math	MTMS 321 | Int'l Business & Ocean Shipp
MTMS 101 | Intro to Maritime Transp	MTMS 361 | Maritime Environment Mgmt
SC 135 | Bus Prof Communications	SOC 157 | Intro to Sociology
WRIT 101 | Interdisciplinary Writing Lab	

Cumulative GPA: 3.18

Internship Activities: COSET Summer Internship Program

Career development activities:

- Breakbulk Education Day 2016
- Fast Forward skills development workshop Texas Southern University
- TSU DHS SLA Seminars

7.4 Ester Martinez-Belmares

Courses completed:

Fall 2016 Semester	*Spring 2017 Semester*
CS 250 | Computer Networks Fund	CS 346 | Database Management Syst
CS 342 | Prog Lang & Design	CS 444 | Operating System
CS 343 | Assembly & Comp Arch	CS 451 | Intro to Wireless & Mobile Net
CS 497 | Adv Topics	CS 457 | Artificial Intel
MATH 473 | Probability & Statistics I	CS 499 | Capstone Proj
	CS 218 | Univers Phys Lab II

Cumulative GPA: 3.67

Internship Activities: IT Business Analyst at Chevron

Career development activities:

- DHS Seminar on "The Future of National Security –Maritime Cybersecurity"
- HEENAC Conference
- Fast Forward skills development workshop Texas Southern University
- TSU DHS SLA Seminars

7.5 Laterrian Perkins

Courses completed:

Fall 2016 Semester	*Spring 2017 Semester*
CS 117 | Intro to Comp Science	MGMT 301 | Database Management Syst
GEOG 132 | World Regional Geography	MKTG 306 | Operating System
ITEC 331 | Technical Writing	MTMS 321 | Intl Business & Ocean Shipp
MGMT 300 | Principle of Management	MTMS 423 | Marine Cargo Operations
MTMS 101 | Intro to Maritime	MTMS 481 | Sem in Int'l Maritime Bus
MUSI UB | University Band	MUSI UB | University Band

Cumulative GPA: 3.54

Internship Activities: COSET Summer Internship Program

Career development activities:

- Workforce Development seminar Houston, Texas
- Fast Forward skills development workshop
- TSU DHS SLA Seminars
- Transportation Research Board Annual Conference
- Thurgood Marshall College Fund Scholarship Seminar

7.6 McKenzi Jones

Courses completed:

Spring 2017 Semester

CS 116 | Intro to Computer Science I

MATH 231 | Elementary Statistics

MTMS 321 | Intl Business & Ocean Shipp

MTMS 361 | Maritime Environment Mgmt

POLS 236 | Texas Government

SPAN 131 | Elementary Spanish

Cumulative GPA: 3.56

Internship Activities: Drainage District 7 Summer Enrichment Program - Port Arthur

Career development activities:

- Fast Forward skills development workshop
- TSU DHS SLA Seminars

8 OTHER COLLABORATIONS

Our faculty members have collaborated with other faculty members at different universities through attending various conferences or workshops, especially those organized by DHS.

- Collaborate with UH

  TSU team has collaborated with Dr. Yupeng Zhang and Dr. Cheng Liang-Chieh, the faculty members at the University of Houston in following aspects:
  - Dr. Yupeng Zhang and Dr. Cheng, Liang-Chieh have been invited as the speakers for the TSU DHS SLA program Seminar and give a presentation on the topic of "The Future of National Security – Maritime Cybersecurity".
  - Dr. Yupeng Zhang has developed a presentation on "Cybersecurity Foundation and Awareness in Maritime" for the DHS SLA program workshop in the future.

Figure 8-1. "Cybersecurity Foundation and Awareness in Maritime" slides developed by Dr. Zhang

- Collaborate with Florida Atlantic University

On December 2016, Dr. Qi attended a one-day workshop on Enhancing Resiliency of Maritime Ports hosted by Florida Atlantic University at Dania Beach, Florida. This Workshop is to develop in-depth knowledge and understanding of the issues in port resiliency and to acquire and share information on current and developing efforts in port resiliency and risk management studies. It invited a range of port and coastal community stakeholders and researchers Dr. Qi was invited as a speaker for this workshop. In the workshop, Dr. Qi introduced the DHS SLA program at TSU and presented the research work that TSU team has been conducting on the topic of "Non-Intrusive Inspection (NII) Technologies for Inspection of Cargo at Ports of Entry". In this workshop, Dr. Qi also met Dr. Manhar Dhanak and Dr. Alka Sapat at Florida Atlantic University. They exchanged their research ideas and discussed the potential collaborations in the future. In July 2017, Dr. Qi provided assistance to Dr. Alka Sapat on conducting a survey to the executives at Port of Houston for a research project on port resiliency.

Figure 8-2. Dr. Yi Qi Presented at the Workshop on Enhancing Resiliency of Maritime Ports

- HBCU Flood and Hurricane Meeting (August 3-4, 2017)

  During August 3-4 2017, Dr. Qi attended the HBCU Flood and Hurricane meeting convened by the DHS Coastal Resilience Center of Excellence. In this meeting, Dr. Qi met researchers in different HBCUs and discussed how to increase the ability of HBCUs to support vulnerable communities to mitigate and recover from disasters caused by floods or hurricanes. After this meeting, Dr. Qi also joined the "HBCU Flood and Hurricane Meeting Attendees Workgroup" to continue the discussions on this topic.

Figure 8-3. Dr. Qi Yi with All Participants at HBCU Flood and Hurricane Meeting

- SIAM annual meeting, Pittsburgh (July. 9, 2017- July.14, 2017)
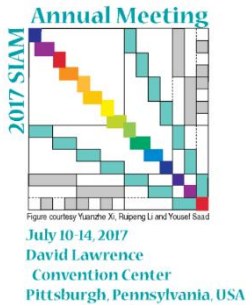
During July 9-14 2017, Dr. Yunjiao Wang attended SIAM annual meeting held in Pittsburgh, PA. SIAM conferences focus on timely topics in applied and computational mathematics and applications and provide a place for members to exchange ideas and to expand their network of colleagues in both academia and industry. The SIAM Annual Meeting provides a broad view of the state of the art in applied mathematics, computational science and their applications. In this conference, Dr. Wang presented a poster of her research "Extend Levelt's Propositions to Multistable Binocular Rivalry".

- Computational and Systems Neuroscience, Salt Lake City (Feb. 23, 2017- Feb. 28, 2017)

During Feb. 23-28 2017, Dr. Yunjiao Wang attended Computational and Systems Neuroscience meeting, and presented a poster titled "Extending Levelt's Propositions to multistable Perceptual rivalry involving interocular grouping" at the meeting. The annual Cosyne meeting provides an inclusive forum for the exchange of experimental and theoretical/computational approaches to problems in systems neuroscience. Cosyne topics include (but are not limited to): neural coding, natural scene statistics, dendritic computation, neural basis of persistent activity, nonlinear receptive field mapping, representations of time and sequence, reward systems, decision-making, synaptic plasticity, map formation and plasticity, population coding, attention, and computation with spiking networks. Participants include pure experimentalists, pure theorists, and everything in between.

- Get SMART Workshop

Dr. Azimi attended the Get SMART Impact Workshop organized by Southeast Maritime and Transportation Center (SMART) in May 2017. The SMART Center is a National Science Foundation (NSF) Advanced Technological Education (ATE) Center in the maritime and transportation industry. There are over 40 ATE Centers across the country focused on improving science, technology, engineering, and mathematic (STEM) education to meet the technician workforce needs of advanced technological industries in the U.S., and SMART is the only ATE Center solely focused on the maritime and transportation industry.

Get SMART was a three-day professional workshop in Galveston, designed on important and required core concepts and materials to develop/expand academic courses and pathways in order to enable students to enter the maritime and transportation industry. During the workshop, speakers from SMART institute and also Port of Galveston had presentations, and the attendees had the opportunity to visit Port of Galveston (boat tour), G&H Towing Company, Vehicle Distribution Center of Wallenius Wilhelmsen Logistics, Texas Maritime Academy at Texas A&M University Galveston Campus, Pier 77 Marine

Service (recreational and commercial full-service shipyard), and U.S. Coast Guard Galveston station.

Figure 8-4. Dr. Mehdi Azimi at Get SMART Impact Workshop

- 2017 Visual Analytics MSI Faculty Training Workshop

Dr. Azimi attended the Visual Analytics MSI Faculty Training Workshop organized by the Visual Analytics for Command, Control, and Interoperability Environments Center (VACCINE) in June. Vaccine is the Department of Homeland Security's (DHS) Center of Excellence in Visual and Data Analytics. The workshop was a two-day event held by Prairie View A&M University in both Prairie View and Houston campuses.

During the workshop, the principles of Visual Analytics and incorporating user feedback and Machine Learning for human-in-the-loop Visual Analytics were introduced to the attendees followed by a hands-on tutorial with Tableau software. Furthermore, the presenters discussed course module development and they shared their course development experiences with attendees. A group discussion was subsequently held on general Visual Analytics lesson development.

Figure 8-5. Dr. Mehdi Azimi with All Participants at 2017 Visual Analytics MSI Faculty Training Workshop

- 2017 Cyber Security Seminar

Dr. Azimi attended an industry seminar hosted jointly by West Gulf Maritime Association (WGMA) and the Baltic International Maritime Council (BIMCO) in August. Globally recognized BIMCO is the world's largest international shipping association, with over 2,100 members in more than 120 countries. Their membership includes ship owners, operators, managers, brokers and agents.

The focus of the seminar was on Cyber Security in the Maritime Environment and it was held at U.S. Coast Guard Sector Houston-Galveston. The program had key presenters from BIMCO, U.S. Coast Guard, Federal Bureau of Investigation (FBI), American Bureau of Shipping (ABS), Hudson Analytix, HUB International, Innove Strategies, and Royston-Rayzor.

Figure 8-6. Dr. Mehdi Azimi at 2017 Cyber Security Seminar

9 PROGRAM ASSESSMENTS

On June 13rd, 2017, Dr. Yi Qi at TSU and Dr. Yupeng Zhang and Dr. Cheng Liang-Chieh, the faculty members at the University of Houston met with External Advisory Committee member Jessica Thomas and Ron Farrow at Port of Houston.

During the meeting, Dr. Qi updated research progress and asked the Committee Members about the current research and training needs related to the maritime port security. According to the discussion in the meeting, TSU team is planning to develop a Cyber Security Awareness Workshop for maritime professionals. This work shop will be provided to our maritime students as well as the current personnel in maritime management and security field.

10 CHALLENGES

An early career faculty member, Dr. Miao Pan, who worked for our program left TSU in year 2016. He was a major investigator for our DHS program, and his responsibilities included both developing new courses and conducting research. To continue the progress of our program, a new computer science faculty member needs to be recruited to take the place of Dr. Pan. Note that, a new faculty member, Dr. Ismet Sahin, from Engineering Technologies department at TSU, just joined our team and took over some of the work that Dr. Pan left. He also need some time to get up to speed.

Another challenge to our program was the catastrophic flooding caused by Hurricane Harvey in the end of August 2017. The floods inundated hundreds of thousands of homes, displaced more than 30,000 people, including our faculty members and students. One major investigator's home is totally flooded and has not been fully repaired yet. This disaster caused delay of our classes, and affected our research progress.