



## **Enhancing the Emergency Management Technology Program**

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# ENHANCING THE EMERGENCY MANAGEMENT TECHNOLOGY PROGRAM

## ABSTRACT

As natural and man-made disasters pose greater risks to communities, the demand for skilled professionals who can manage and mitigate their effects continues to grow. Jackson State University's Emergency Management Technology (EMT) program was originally developed with assistance from the US Department of Homeland Security (DHS). The EMT program strives to prepare the next generation of emergency management professionals with the knowledge and skills they need to improve outcomes in disasters of all types. In 2014, Jackson State University (JSU) received two additional grants (from DHS and Nuclear Regulatory Commission, respectively) to augment the EMT program with new curriculum and state-of-the-art laboratories. One of the DHS Center of Excellence (the Coastal Hazards Center of Excellence) is also engaged to provide expertise and guidance in order to enhance EMT program's research capabilities.

## 1. INTRODUCTION

In 2005, Hurricane Katrina [1,2] devastated the Mississippi coastal area. Hurricane Sandy slammed the eastern seaboard in 2012. Every year, many Americans face a disaster or emergency and its horrifying consequences. The need for specialists in the field of emergency management has never been greater. Those in the field of emergency management must have adequate training, experience, and education.

The Department of Technology at Jackson State University has established a concentration in Emergency Management Technology to prepare our students as Emergency Management professionals. The university approved the curriculum for Emergency Management Technology program in the Fall of 2010. The program began admitting students in Spring Semester of 2011. The curriculum focuses on topics such as emergency planning, incident command, disaster response and recovery, hazard identification and mitigation, agency coordination, homeland security, and community emergency training [3].

The primary goal of the EMT program is to help students gain a well-rounded skill set that will allow them to succeed in a homeland security or emergency management position. To reach this goal, the existing courses in Emergency Management Technology need be enriched to induct contents of telecommunication, nuclear technology, nuclear emergency preparedness, and atmospheric dispersion model into the curriculum. Besides developing new course and course modules, this project team also revises several existing courses. Emergency management encompasses a wide range of activities and is a multi-disciplinary endeavor. Faculty and program collaboration is becoming increasingly necessary in the preparation of the future homeland security workforce. To further enhance the EMT program, the Department of Technology made efforts to collaborate with other academic disciplines. To have students with more experience in these matters, the EMT program has collaborated with the Computer Science Department and Atmospheric Science program in the Physics Department.

It is believed that technology concepts are best learnt with hands-on activities. Therefore, along with enhancing EMT's existing curriculum, this project team also works on adding and upgrading the laboratory facilities. EMT program purchases new equipment to establish

“Radiation Instrumentation and Measurements” Laboratory, “Mobile Device Application” Laboratory, and Amateur Radio Station. The “Geographic Information System (GIS) and Remote Sensing” Laboratory has also been upgraded. Student research is also a highly important component. Many benefits can be derived from doing research. Students who have completed some introductory courses are participating in research projects.

## **2. PROGRAM DEVELOPMENT**

During the Spring of 2010, JSU’s Technology Department was selected to receive a grant from the U.S. Department of Homeland Security to establish an Emergency Management Technology program and offer scholarships. In September 2011, Technology Department received another grant from DHS, through its Science, Technology, Engineering, and Mathematics Career Development Grants program. This grant enabled EMT program to award scholarships to more undergraduate students who demonstrate career interest in Homeland Security. In 2014, Jackson State University received two additional grants, from DHS and Nuclear Regulatory Commission (NRC), to augment the EMT program with new curriculum and state-of-the-art laboratories.

The EMT Program is an interdisciplinary venture. The curriculum covers EMT-related theories and principles as well as their applications, including the interpretation of hazard, vulnerability, and risk-related data and literature. Courses also explore the major principles of this cross-disciplinary field that integrates all activities necessary to build, sustain, and improve the ability to mitigate, prepare for, respond to, and recover from threatened or actual natural disasters, acts of terrorism, or other man-made disasters. Students can gain an essential understanding of the mission and principles of emergency management technology with an emphasis on management, use of technology, and cross-agency collaboration. Emergency Management Technology graduates will have an easier transition to the workplace.

## **3. CURRENT STATUS**

The Emergency Management Technology program began admitting students in Spring Semester of 2011. A bachelor’s degree with a concentration in Emergency Management Technology requires the successful completion of 124 credits of coursework. Students are required to complete the university’s 43-hour Liberal Studies component. Other program requirements, outside the major department, supplement the major with additional math and science courses that can enhance the student’s success in the major and in practice. Those requirements include Trigonometry, Calculus, Biology, Chemistry, and Physics. The EMT program is accredited by the Association of Technology, Management, and Applied Engineering (ATMAE).

One current area of focus is to convert all EMT courses to web-enhanced courses. These traditional classroom courses incorporate online components to facilitate communication and discussion and to provide students with enhanced content, extend communication, and provide links to other resources. This allows students additional exposure to course content that is not possible in a traditional classroom environment.

EMT students have attended many conferences, such as International Disaster Conference and Expo, Mississippi All-Hazards Emergency Preparedness Conference, Homeland Security Symposium, Annual Emergency Management Higher Education Conference, International Conference of Emergency Management, Career Pathway Conference for future Homeland Security S & T professionals, Mississippi Academy of Sciences Annual Meeting, and ATMAE Annual Conference. The students had the opportunities to present research papers, participate in

workshops and social events, as well as to interact with the representatives from federal, state, and local governments, hospitals, charity organizations, and private sector.

During the past several years, the EMT program has placed students into internship positions at the National Transportation Security Center of Excellence at Tougaloo College, National Weather Service (Jackson, Mississippi), the National Oceanic and Atmospheric Administration, Coastal Hazards Center of Excellence at JSU, Vicksburg Police Department's Community Resource office, Disaster Preparedness & Response - Catholic Charities, JSU's Emergency Operation Center, Salvation Army Disaster Team, Yahoo County Emergency Management Office, Hinds County Department of Emergency Management, Calumet Memorial Park District (Calumet City, IL), and Homeland Security Studies and Analysis Institute (Washington DC). The EMT program will continue expanding its student internship program.

#### **4. ENHANCEMENT AND REFINEMENT OF EMT PROGRAM**

Emergency management is a multi-disciplinary endeavor. To continue developing and refining the program, we conducted surveys asking emergency management professionals to provide their opinions. The experts have suggested several ways to improve the EMT program.

First, it is known that telecommunication systems provide critical information exchange paths before, during, and after a disaster. Reliable telecommunication systems are essential for warning the public and governments of an impending emergency and for allowing emergency management personnel to communicate during an emergency to share information and coordinate response actions. Emergency management professionals need to be familiar with the basics of telecommunication.

Second, atmospheric dispersion model provides a useful tool for evaluating releases of hazardous chemical agents, estimating the downwind dispersion of a chemical cloud, and determining threat zones associated with several types of hazardous chemical releases. For many years, communities have prepared themselves to deal with accidental atmospheric releases from industrial sites, energy facilities, and vehicles transporting hazardous materials. However, after September 11, 2001, the communities must also worry about the terrorist threat of the intentional use of chemical, biological, and nuclear agents. Because of this threat, the ability to predict and track the dispersal of harmful agents has become one critical component of anti-terrorism, which is the primary charge of Department of Homeland Security. One of our nation's capacities to respond to the stand of atmospheric hazardous material events is dispersion models that predict the path and spread of the hazardous agent. Tracking and predicting the atmospheric dispersion of hazardous material releases examines our nation's current capabilities in these areas and provides recommendations for strengthening them. The DHS relies on results from atmospheric dispersion models for threat evaluation, event management, and post-event analyses. The ability to simulate hazardous agent deposition rates is a crucial part of our emergency preparedness capabilities. Therefore, the atmospheric dispersion model plays an important role in the prediction of hazardous materials release.

Nuclear disaster in Japan (the Fukushima Daiichi Nuclear Power Plant Accident) led to serious concerns related to the contamination in public domain. Nuclear emergencies can arise due to factors beyond the control of the operating facilities. However, through certain pre-planned and established structural and non-structural measures, various stakeholders can still manage such emergencies to minimize risks to health, life, and the environment. The EMT program strives to prepare the next generation of emergency management professionals with the knowledge and

skills they need to improve outcomes in disasters of all types. Therefore, EMT program needs to train its students to not only be emergency management and preparedness professionals who protect the general public from any potential nuclear/radiological incidents, but to also be radiation protection specialists who work at nuclear facilities.

#### **4.1 Curriculum Enhancement**

The primary goal of the EMT program is to help students gain a well-rounded skill set that will allow them to succeed in a homeland security or emergency management position. To reach this goal, the existing courses in Emergency Management Technology need be enriched to induct contents of telecommunication, atmospheric dispersion model, and nuclear technology into the curriculum. This can be accomplished by introducing one new course and two new course modules.

##### **4.1.1 New Course Module: Telecommunications and Emergency Management**

Telecommunication systems provide powerful and flexible tools to enable emergency management personnel to cope with crisis. The mobile telephony, Internet, and satellite communications provide unprecedented communications capabilities to a wide range of communities in disaster areas. Communication systems have provided the critical path for relief during any emergency situation. Communication capability is an integral part of disaster response and recovery plans. Therefore, emergency management professionals must be sufficiently knowledgeable of the various communications systems.

A course module has been developing to be presented to EMT students as an overview of the rapidly advancing technology in telecommunications. The course module covers the fundamentals of current communication systems such as cellular, WLANs, radio, satellites, and Internet. Through classroom instruction and hands-on training, this course module can also present the essential concepts and techniques of emergency telecommunications to provide students with a basic understanding of the various system options open to the emergency management professionals.

##### **4.1.2 New Course Module: Introduction to Atmospheric Dispersion**

This module can provide EMT students with an intense path to learn the basic theory of dispersion model (i.e., HYSPLIT) [4] and its application for emergency management. The EMT students have an opportunity to learn the basic theory of atmospheric dispersion and to understand how a pollutant concentration is computed. The HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model is a complete system for computing trajectories complex dispersion and deposition simulations using either puff or particle approaches. It consists of a modular library structure with main programs for each primary application: trajectories and air concentrations.

##### **4.1.3 New Course: Introduction to Nuclear Technology**

This new course consists of introducing five new modules (Nuclear Radiology, Nuclear Power Technology, Nuclear Safety, Nuclear Health, and Nuclear Waste Management). These modules provide students with broad and in-depth knowledge of the nuclear field. The topics covered can facilitate the students to become self-sufficient in seeking higher education, research, or employment in nuclear industry and associated fields.

## **4.2 Revision of the Existing Courses**

Besides developing new course modules, this project team also revises two existing courses - ITEM 402: Basic Geographic Information System and Remote Sensing (GIS/RS) and ITHM 405 Risk Assessment.

The ITEM 402 course introduces the theory and techniques of Geographic Information System (GIS) [5] and Remote Sensing [6] and their application. To enhance the GIS technology application in emergency management, the course instructor incorporates more emergency management resources in the GIS section. These include Hazus Multi-Hazards (MH) [7], Areal Locations of Hazardous Atmospheres (ALOHA), and HYSPLT model.

EMT program also re-structures the Risk Assessment course. In the revised Risk Assessment course, a great deal of emphasis is placed on Probabilistic Risk Assessment (PRA) techniques. PRA (also known as probabilistic safety assessment) is used to predict the future behavior of processes generally in terms of likelihood and outcome (severity). PRA has been used to assess the designs of high hazard, complex, low risk systems (such as chemical manufacturing plants and nuclear power plants). PRA examines events that contribute to adverse outcomes through the use of event tree analysis and determines the likelihood of event occurrence through fault tree analysis.

## **4.3 Establishing and Upgrading Laboratories**

It is believed that technology concepts are best learnt with hands-on activities. Students are attracted to practical-oriented courses and motivated by meaningful projects. To draw the attention of students with different backgrounds and promote recruitment and retention, a laboratory environment is essential. Adding and upgrading the laboratory facilities is critical for the productivity and viability of the new courses.

### **4.3.1 Mobile Device Application Laboratory**

Mobile technology has expanded dramatically around the world. Mobile devices can assist with public safety, disaster planning, and crisis response. Mobile devices (iPads, smart phones, etc.) are acquired to set up the Mobile Device Application Laboratory. This lab can allow students to experience hands-on activities and give them practical oriented training in the lines of present day technologies.

### **4.3.2 GIS and Remote Sensing Laboratory**

The Department of Physics, Atmospheric Science & Geosciences recently upgraded its GIS and RS Laboratory. The Lab is equipped with high speed workstations as well as image processing and GIS software. The laboratory is maintained and managed by faculty and staff with solid backgrounds in computer science, modeling, GIS, and remote sensing experiences.

### **4.3.3 Amateur Radio Station**

Because of its geographical location, the State of Mississippi is repeatedly subject to hurricanes, tornadoes, ice storms, flooding, and other types of emergencies. In past years, we learned a lot of lessons from disasters. Communication failures are caused by power lines and communication towers being down. People are then unable to know what has occurred in the disaster-affected areas. When normal communications systems are not available, amateur radio stations may make transmissions necessary to provide essential communication needs. Amateur radio operators

(also called ham radio) are in a unique position to render critical public service [8,9]. This laboratory can provide our emergency management technology major students with training in many aspects of communications and radio technology.

#### **4.3.4 Laboratory (Radiation Instrumentation and Measurements) Module**

The EMT program has also added a laboratory module on radiation instrumentation and measurements. Radiation detection and measurement is used to monitor normal operations, detect and analyze abnormal conditions, and ensure safe operation in nuclear facilities. EMT program has acquired new radiation detection equipment for teaching laboratory. The laboratory activities introduce students to various types of detectors used to measure radiations and the general properties of radiation detection systems. The hands-on equipment operation training can further enhance the students' educational experience. This laboratory module can be infused in new course (Introduction to Nuclear Technology) and other existing courses.

#### **4.3.5 Virtual Reality Teaching Program**

The greatest challenge facing emergency response personnel is the ability to train effectively. Recent information technologies make it possible to have a wide set of innovative training tools [10,11]. Among these, virtual reality and environments have a great potential to enhance the learning process. Virtual environments (like Second Life) can provide users with the opportunity to create an emergency situation that could not otherwise be experienced due to safety, cost, and environmental factors [12,13]. This can provide students with a hands-on experience that is more realistic and immersive than any classroom scenario can provide. Thus, students have the opportunity to become better equipped to handle real life situations. Students can make appropriate decisions on urgent matters because virtual environments have given them a tool through which they have developed skills in a safe yet virtually real environment. Due to these advantages in practice, virtual reality and visual simulation have been widely used in emergency training.

This project uses Second Life to develop computer-based training materials and exercises. The training materials offer a variety of environments with customized buildings, objects, and scripting tailored to various scenarios of nuclear emergencies. By using Second Life, instructors can involve a group of students to conduct a virtual live exercise.

### **5. PARTNERSHIP**

Partnerships and collaborations with industry, research laboratories, and government are vital for program development and faculty self-education. EMT program partners with Mississippi Radiation Response Volunteer Corps (MRRVC) [14], which is sponsored by Mississippi State Department of Health (MSDH). MRRVC is composed of a group of professionals whose expertise is in the field of radiation safety and control. The MRRVC was developed to serve the public during radiological emergencies. The mission of the MRRVC volunteer is to aid the community through preparedness by educating and training the public and providing assistance during a radiological incident. All EMT students are encouraged to join MRRVC. After receiving proper training, the students can help the public in emergency response during a radiological event.

In recent years, JSU's Technology Department has also established a working relationship with the Mississippi Citizen Corps Council through a program called Community Emergency

Response Team (CERT) [15]. CERT is a training program that educates people to help themselves, their families, and their neighbors in the event of a disaster when professional responders are not immediately available to help. The JSU CERT program has trained more than 200 Tougaloo College and JSU students, faculty, and staff.

The Coastal Hazards Center of Excellence (CHC) at JSU aims to enhance the nation's ability to safeguard populations, properties, and economies as it relates to the consequences of catastrophic natural disasters. CHC seeks to develop new technologies and tools to help increase the resilience to natural hazards in coastal areas. CHC research focuses on coastal hazard modeling, engineering to enhance the resilience of the built and natural environment, disaster response and social resilience, and planning for resilience. We found a very good match between CHC and aspects of the Emergency Management Technology program.

EMT program has formed a partnership with CHC. CHC offered internship positions to EMT students. We intend to expand this partnership. CHC has agreed to accommodate faculty-students teams to conduct research at its facility. Thus, EMT faculty-students teams can have the opportunity to work with CHC researchers engaged in homeland security research.

### **5.1 Collaborative Research Projects with DHS Center of Excellence**

EMT faculty-students research teams are collaboratively working with researchers at DHS Center of Excellence (COE). One of the researches conducts the model simulations by using a suite of state-of-the-art numerical forecast and surge models to compute still-water elevations along the coasts of the Gulf of Mexico. The research focuses on the surface-atmosphere interactions and planetary boundary layer (PBL) processes. PBL processes impact the development of hurricanes. The PBL is the lowest layer of the troposphere separating the ground from the free troposphere. The characteristics of the PBL are different over geographic regions with variations in the underlying surface, such as coastal areas, mountainous areas, and irrigated cropland.

The calculation of coastal surge requires accurate physical parameterizations in numeric weather models to properly account for the processes in atmospheric and oceanic boundary layers. In particular, EMT faculty and student researchers address some key problems associated with PBL parameterizations that represent the momentum, energy, and mass exchanges between land, ocean, and atmosphere. These key problems include the applicability of Monin-Obukov similarity theory over inhomogeneous surfaces and complex terrains such as Gulf coasts, and the roles of land-atmospheric exchanges of momentum, heat, and water vapor.

Participation in social media sites has grown exponentially over the past decade. These social networks are changing the way people communicate not only in their day-to-day lives, but also during an incident [16.17]. The public is turning to social media technologies to obtain up to date information. Social media has become an integral part of emergency management and disaster response. Therefore, drawing up an effective social media strategy, aggregating data from multiple social media sources, and facilitating real-time information sharing should be a crucial part of disaster preparedness and response.

Social media has served several functions in the wake of disasters such as alerting and warning the public, disseminating information to mass audiences, allowing citizens to exchange information amongst themselves, coordinating logistical tasks, self mobilization, and rumor management [18]. There are several studies that have been done focusing on social media data



analysis after a natural disaster has occurred, but virtually none of these studies have focused on aggregating data from multiple online social media sources from government, business, and non-profit response organizations in an effort to facilitate real-time, cross-sector information sharing and decision making. One of the research areas of the Coastal Hazards Center of Excellence at JSU focuses on Emergency Management Analytics.

It is our hypothesis that aggregating data from multiple social media sources during a disaster and packaging them in one central location should be an innovative way to communicate restoration decisions and status across all public, private, and non-profit response stakeholders in real time because it is not feasible for a person to search through pages of information attempting to receive guidance on how to respond in emergency situations. This type of information should be at one's fingertips when needed. There are several underlying research questions that may be answered in the interim:

How do we coordinate and aggregate public data into official reporting?

Which social media functions should be included in the centralized portal?

Which organizations should be included?

Once the methodology is executed, the launch of an official state-wide social media site would be appropriate. Advertising this site pre-disaster should make the public feel more secure in trusting the information posted post-disaster. Once the website is launched, the social media application can be ported to an app available for smartphones. For emergency management organizations and field workers, this would be an ideal resource. They should be able to interact with their organizations as well as across others to assist in post-disaster recovery efforts in real-time.

CHC at JSU is working on advancing understanding of natural disaster resilience and transferring that knowledge into action, resulting in reduced loss of life or injury and lessened damages to the built and natural environment. Social media technologies can improve natural disaster resilience. EMT faculty and student research team is collaborating with CHC for this study.

## **6. PROGRAM ASESSEMENTS**

The objectives of this program are:

1. to introduce new courses and improve laboratory environment to create a meaningful learning environment;
2. to recruit students to participate in the EMT program;
3. to increase students' research ability and interest in HS-STEM fields; and
4. to enhance partnerships with DHS Center of Excellence

The program development has been successful and is meeting the initial goals. Our forecast is for continued program growth. The formal survey regarding student learning outcomes will be conducted. Student recruitment, retention, and placement will be recorded. The experiences and lessons-learned from this program will be shared with the engineering and technology education community.

## **7. CONCLUSIONS**

The baccalaureate program in Emergency Management Technology was initiated at Jackson State University with support from the US Department of Homeland Security. The EMT

program began admitting freshmen and transfer students in Spring Semester of 2011. The first batch of students graduated from the program in Spring of 2013. The availability of scholarships from the DHS has helped to attract top students to this program, thereby challenging both faculty and students to achieve their highest academic potential.

The EMT program is expected to offer complete and up-to-date curriculum as well as state-of-the-art laboratories for its students. In order to attract more support for EMT program, the EMT faculty members have submitted several proposals to the federal and local agencies. The recent grants from DHS and NRC have allowed the EMT program to provide students with a diverse and newly developed set of course and course modules as well as an integrated laboratory environment. Students can participate in the activities through coursework, laboratory practices, and research, and will later attend conferences to present research papers. The EMT program will be constantly revamping the curriculum to meet the expectations of industry by supplying qualified technologists who have extensive practical knowledge and hands-on experience.

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