Civil & Environmental Engineering
Graduating Students That Will Build The World

Improving Public Safety with Data-Driven Decisions

2016 Spring Newsletter
In the last decade alone, nearly 400,000 people have died as a result of traffic crashes in the United States. Another 23 million people have been injured. The toll on society is more acute “because the victims are overwhelmingly young and healthy prior to their crashes” (www.scienceservingsociety.com/traffic-safety.html). The Civil and Environmental Engineering Department at the University of Utah (CvEEN) has partnered with the Utah Department of Public Safety (UDPS) and Utah Department of Transportation (UDOT) to create the Utah Transportation and Public Safety - Crash Data Initiative (UTAPS-CDI). Under this initiative, the CvEEN Department will work closely with state and federal agencies, as well as other stakeholders, to engage in data-driven approaches to the “4Es” of road safety management (engineering, education, enforcement, and emergency services) with the objective of developing safer roadways, safer drivers, and addressing the unique needs of high-risk groups.

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Led by U civil engineering associate professor Richard J. (R.J.) Porter, research assistant professor Juan Medina and programmer/analyst Brendan Duffy, UTAPS-CDI will create an effective solution to Utah’s needs to maintain and analyze crash data and to improve road safety through scientific research, workforce development, and technology transfer. The effort is beginning with the Utah Traffic Lab at the University of Utah becoming the host and manager of data on all reported traffic crashes throughout the state. Every record will contain information about the crash, ranging from the location, the sequence of events leading to the accident, the severity of the injuries, and many other characteristics about the drivers, occupants, vehicles, roadways, and weather conditions. As the crash data stewards, researchers in CvEEN will monitor and ensure data quality, generating unique opportunities to identify safety issues and formulate data-driven decisions. Such an approach will help in identifying and designing effective safety countermeasures while opening a wide range of new research opportunities. As described by UDOT’s safety programs engineer, Scott Jones, “UTAPS-CDI is an exciting project for UDOT. We expect to streamline our workflow and improve our database services. The CDI will be an important decision-support tool for our highway safety programs.”

Only a few other universities in the country have taken steps to host crash databases with the purpose of serving their state partners while also providing related research and education opportunities for students and faculty. The University of Alabama’s Center for Advanced Public Safety (CAPS) and Louisiana State University’s Highway Safety Research Group (HSRSG) are examples of such initiatives. CvEEN researchers visited CAPS and HSRG to learn from their research groups and devise the best approach for Utah. UTAPS-CDI officially kicked off last fall with Phase I. Phase I encompasses the creation of the database system, data storage and management for UDPS and UDOT, and development of research programs using the crash data. Phase II is envisioned to further extend UTAPS-CDI to directly support data quality control processes, create data interfaces and real-time reporting, and set forth the first research projects using the new crash database. The State of Utah is required to report specific crash information to the Federal Highway Administration and the National Highway Traffic Safety Administration to support programs such as the Highway Safety Improvement Program, Fatality Analysis Reporting System (FARS), and the Motor Carrier Safety Assistance Programs. UTAPS-CDI will help the State maintain accurate and consistent records for such programs, contributing to more precise assessments of the State’s policies at a national level.

Support from all partners has been remarkable, and UTAPS-CDI is already studying opportunities for future extension of their services to additional stakeholders. Gary Mower, crash data program manager at UDPS, sees the initiative as “an opportunity for developing effective strategies to improve safety on our roadways and supporting the effort to reduce the frequency and severity of motor vehicle crashes in Utah and throughout the country.”
Collaborating Around the Globe

During its first year, the U.S.-Pakistan Center for Advanced Studies in Water (USPCAS-W) at the U enhanced the capacity of its sister center housed at Mehran University of Engineering and Technology (MUET) in Pakistan through a range of collaborative efforts. This included three training missions to Pakistan, a course-partnering program, and a dedicated team housed at MUET. This partnership has facilitated the creation of three new degree programs at MUET around water and is now laying the groundwork for a fourth. The project also helped draft a university-wide gender policy for MUET.

The missions to Pakistan brought together a cross-section of faculty members from the U and elsewhere to offer training on subjects including teaching, research, WEAP modeling, field work, and more. The missions also take advantage of the expertise of those visiting to drive large-scale workshops that draw people from across Pakistan to discuss issues like water and technology venture commercialization. These larger activities have brought together government officials, industry leaders and more.

In January, the first round of visiting faculty from MUET arrived for the spring 2016 semester. Along with participating in classes and a weekly seminar, they are engaged in joint research projects with their faculty hosts. University of Utah associate professor Ramesh Goel is hosting professor Rasool Bux Mahar. Their research effort is investigating the occurrence and spread of antibiotic resistant bacteria (ARB). This semester they are isolating ARBs from wastewater treatment plants with the aim to develop disinfection kinetics. U associate professor Steve Burian is hosting professor Rakshinda Bano and working with her to develop a water management computer model of the Indus River Basin in Pakistan. Their research is advancing the ability to simulate climate impacts on water flows in the Indus River and supporting decision making now and in the future. Assistant Professor Sarah Hassan is working on a project to synthesize silver nanoparticles for sensing and treatment applications. Assistant Professor Uzma Imran is studying water quality of the source supply for Karachi, Pakistan.

The collective work of the visiting faculty will advance the research capacity at MUET as well as the continued projects between MUET and the U of U faculty and the research of graduate students at the U. On returning to Pakistan, they will disseminate the knowledge gained at the U to young faculty and students at MUET to enhance research infrastructure and prepare a cohort of engineers and scientists to address issues in Pakistan related to water treatment, hygiene, health and best environmental engineering practices.

The research for this award focuses on nuclear forensics. Nuclear forensics is the physical and chemical characterization of illicit nuclear material and any associated material to develop correlations with materials production history and potential use; thus providing evidence for its attribution. Signature analysis is often performed in nuclear forensics to identify unique physical and/or chemical properties of the interdicted material that provides evidence for its attribution. The current signatures are focused primarily on the uranium and plutonium compositions (i.e. concentrations and isotopic ratios) and bulk physical appearance (i.e. size, shape, and material type). Modern research in nuclear forensics explores alternative physical and chemical properties which could also identify the origin or intended use of the material.

This research is funded by the Department of Homeland Security – Domestic Nuclear Detection Office – Academic Research Initiative, and will support three Ph.D. students, one staff scientist and one faculty member at the University of Utah.

Professor Luther McDonald Awarded Grant

Professor Luther McDonald was recently awarded a five-year, $1.2 million grant by the Department of Homeland Security to investigate novel signatures of uranium materials based on high-resolution imaging of surface textures (i.e. morphology and microstructure). A primary objective of the research is to determine how the morphology and microstructure that stabilized in uranium ore through specific geological timeframes scramble once they are removed and reacted upon in uranium oxides relevant to nuclear weapon development.

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Amanda Bordelon, an assistant professor in the Department of Civil and Environmental Engineering, is working on smog-eating concrete.

She has a long background in researching additives in concrete mixtures, previously specializing in fiber-reinforcement which reduces crack widths in various building structures and pavements. Now she is also researching the concrete’s addition of titanium dioxide (TiO2), known as a photocatalytic material. When the TiO2 is exposed to UV light, it can react with the air and break down key pollutants like nitrous oxides (NOx), sulfuric oxides (SOx), and volatile organic compounds (VOCs).

The addition of TiO2 nanoparticles intermixed with cementitious materials was first presented around 2006 in Europe. This combination has been coined “Smog-Eating Concrete” and in the United States has already been implemented in several trial pavement sections in Washington and Kansas. The effectiveness of this photocatalytic particle to air pollution reduction is typically measured with samples put in a chamber subjected to NO gas and UV light, and monitoring the amount of NOx reduced or converted to a weak nitric acid HNO3. The major challenges to implementing this technology has been the expensive cost of the TiO2 (seven times more expensive than cement), and the recent testing of this technology indicates that it only works at cleaning the air efficiently for about one year or less. The TiO2 photocatalytic technology still has high potential for success if the air reduction can be maintained.

For the research being performed here in Utah, Bordelon’s research group is primarily studying the longevity of the air reduction by monitoring the chemical interactions between the underlying concrete and the surface TiO2. Throughout 2016, research samples of the Smog-Eating Concrete can be found on the roof of the Meldrum Civil Engineering Building, and as panels that people can walk on (to study wear resistance) at the new Quinney Law Building’s roof terrace.
The University of Utah team will participate in the 2016 concrete canoe competition at the ASCE Rocky Mountain student conference. The students will have to design, build, and race their concrete canoe. The three highest scoring teams advance to the national concrete canoe competition.

The ASCE concrete canoe competition will be held in Denver, Colorado, March 31 - April 2, 2016. Eighteen ASCE Student Conferences are held every spring. The 2016 team consist of nine students ranging from freshman to graduating seniors.

Concrete Canoe gives students the opportunity to develop leadership and teamwork skills and make valuable industry connections.

The department will be hosting the 2017 ASCE Rocky Mountain Regional Conference on April 6-8th. For more information please contact the department at 801.585.7710.