



Department of
Civil & Environmental Engineering
THE UNIVERSITY OF UTAH

**2020 Spring
Newsletter**

Civil | Construction | Nuclear



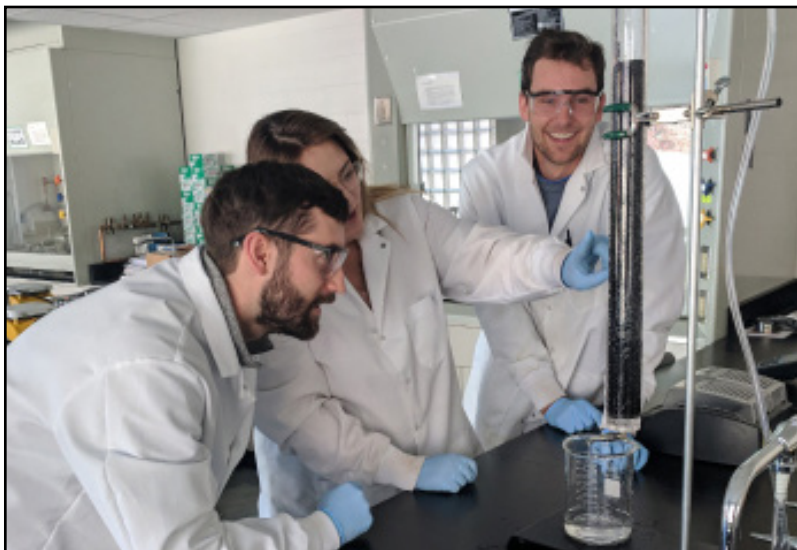
Dr. Andy Hong Awarded Research Funding

The Bureau of Reclamation, under the US Department of the Interior, is sponsoring a project that is being directed by Professor P.K. Andy Hong that focuses on disruptive transport ozonation and sand filtration system. The project was chosen to pilot test ways to pretreat and maintain safe water supply during harmful algal bloom events.

Harmful algal blooms are increasingly occurring in inland and coastal waters, threatening water sources and the natural way desalination occurs in the environment. Oceanic harmful algal blooms are a recurring global issue that causes an annual economic loss of over \$400 million in 2000 according to Hong.

Freshwater harmful algal blooms have increased in severity and frequency over the past 6 years. In 2014, Ohio experienced drinking water contamination for more than 500,000 people and in 2016 Lake Okeechobee of Florida a bloom severely impacted aquatic life and tourism for the area. These harmful algal blooms are a growing concern, including Utah Lake, south of Salt Lake City.

Hong noted that while strategies like nutrient reduction, early detection and mitigation during these events help but more needs to be done with to develop another defense and technology will help provide some solutions to these situations. The research in this project hopes to find ways to help defend against the algal blooms. “The system transports and treats impaired water at once by rupturing cyanobacterial cells, enables coalescing of the cell debris and toxins into large particulates, and further enables their removal by sand filtration to prevent toxins and organics from fouling desalination membranes and disrupting water supply,”



The team working on this problem is Dr. Andy Hong and Dr. Ramesh Goel from the University of Utah.

Tackling Algal Bloom Formation in Utah

According to the Utah Division of water quality, Utah Lake has experienced severe harmful algal blooms in recent summers. Utah Lake, located 38 miles south of Salt Lake City, was closed to the public between 2016 and 2019 due to high cyanotoxin concentrations produced by cyanobacteria, which can cause severe problems to ecosystems, human beings and some other aquatic lives.

Hanyan Li, an environmental engineering doctoral student under the supervision of University of Utah civil and environmental engineering professor Ramesh Goel, is working with three different objectives in her research to better understand how these blooms grow:

The first is to study the microbial community composition, focusing on cyanobacteria and their response to the surrounding environment. Some of the conditions they evaluate include temperatures, pH, and nutrients.

The second objective is to examine the metabolisms of the bacterial community by determining the gene encoding production, nitrogen-fixation and phosphorous uptake mechanisms.

“Basically, nitrogen and phosphorus are two important nutrients that are promoting and sustaining harmful algal blooms.” Li noted. “Nitrogen-fixation strategy is an important tool for cyanobacteria to bring new nitrogen source into the ecosystem and fuel the phytoplankton community, while the phosphorous

strategies help some cyanobacteria to compete with others and utilize organic phosphorous when free inorganic phosphorous is limited in summer.”

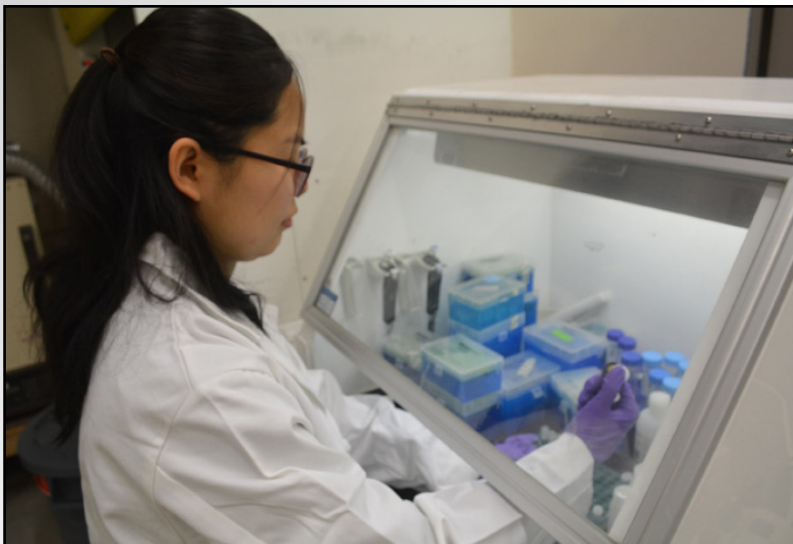
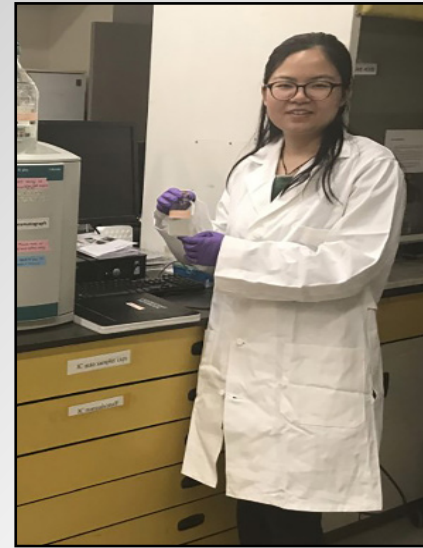
The final objective is studying the interactions between sediment and the water column. Li studies the retention and release of nutrients between

the sediment and the water column. Through the research, they found the internal phosphorus loading that the sediment added to the water column may account for a significant amount of the total nutrient loading in Utah Lake.

“We concluded that the sediment tends to release phosphorous at lower water phosphorous conditions but holds phosphorous at high ambient phosphorous conditions.” Li explained.

Utah Lake’s sediment is known for holding endogenous phosphorous loadings and acts as a self-cleaning system. The system removes phosphorous from the water column by mineral precipitation in calcite. However, in some scenarios during the short-term batch study, the extra phosphorous added in the water column did not all disappear. This indicated the system may not clean all the extra phosphorous in the short-term under some conditions.

Li is expanding the focus to the molecular level through her research and is gradually starting to identify the species of bacteria that are causing these blooms. She is looking toward more advanced techniques to analyze the biology of the species of blooms. After graduation, she wants to focus on research to identify and solve new problems. “I want to find new techniques to remove hazardous material and make the Earth better.”



From Traffic Jams to Traffic Planning

Sitting in the daily traffic jam is what inspired Nima Haghighi to pursue transportation engineering. Growing up in Iran, he was always fascinated by the buildings and structures around him. His fascination then turned into inspiration.

“I wanted to make something that I could see,” he said. “I saw the buildings around and was curious how they were built and designed.” The desire to see the tangible work made him pursue civil engineering.

After graduating with a bachelor’s degree in civil engineering and a master’s in transportation engineering in Iran, Haghighi’s education took him to Utah. “I was looking at five or six universities and the University of Utah was one of them. I found [U civil and environmental engineering associate professor] Cathy Liu’s web page and read about the research she was doing,” he explained. “I talked with her and was really interested.”

He noted that Liu was working beyond typical transportation engineering; she was combining engineering, data analysis, computer science, algorithms and more as a method of transportation planning.

During his Ph.D research at the U, Haghighi was working on research projects that would eventually get him a job after graduation. He collaborated with transportation management consulting firm, Resource Systems Group, Inc., on a research project outsourced by the Utah Department of Transportation. RSG later offered him a job as a travel modeling and transportation analyst.

“I help transportation agencies to make informed decisions. I have experience in developing, calibrating and validating travel demand models,” he said. During his first year at RSG, he worked on developing, modifying and calibrating travel demand models in San Diego, Nashville and Utah.

Currently, Haghighi is working on many different



research projects similar to what he was doing at the University of Utah but on a larger scale. He has expanded his transportation engineering skills beyond the local Salt Lake City area to major cities across the United States.

Haghighi noted that the U’s Department of Civil and Environmental Engineering doctoral program prepared him for his career and taught him new skills.

“The most important thing I learned during my graduate program was critical thinking — how to analyze different research and projects to come up with solutions for the problems that were identified.”

From Chemical Engineering to Nuclear Forensics



University of Utah alumnus Ian Schwerdt started his journey at the U as an undergraduate Chemical Engineer, however it did not take long for Schwerdt's fascination with Nuclear Engineering to ignite. "One of the coolest experiences was watching the blue glow of Cherenkov radiation from the TRIGA reactor. It was one of the defining moments of my undergraduate career."

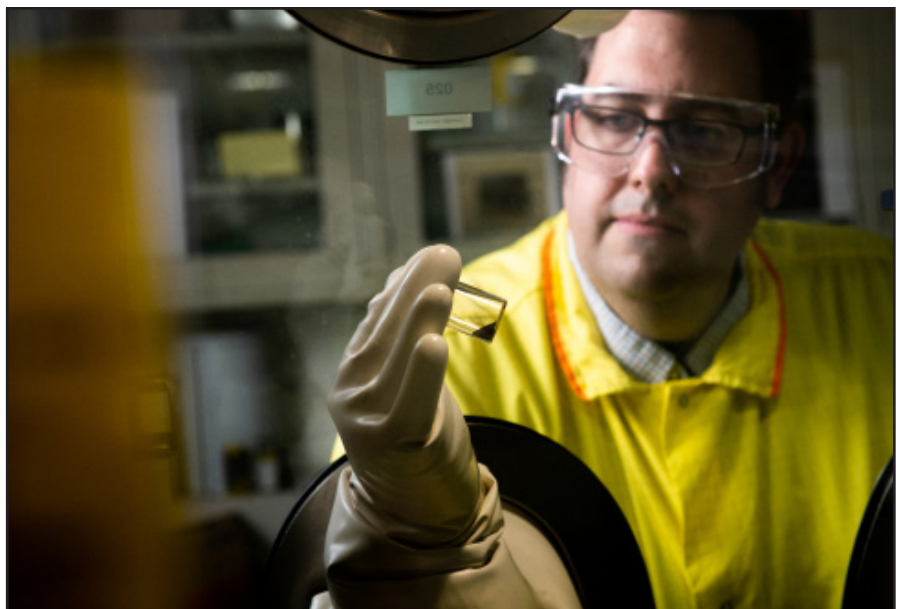
After graduating and working in the semiconductor industry for approximately two years, then he jumped at the opportunity to study nuclear forensics at the University of Utah. "I really wanted to focus on nuclear forensics." Schwerdt said "My friend knew of my strong desire to work in nuclear forensics, and when he joined Dr. Luther McDonald's group, he let me know almost immediately that the University of Utah was now an option." Schwerdt quickly applied and started his studies at the U.

During his Ph.D career with the Department of Civil and Environmental Engineering, Schwerdt focused his research on understanding the impacts of processing conditions on the morphology of uranium oxide. This research provided Ian the perfect formula for the next step in his career. After graduating with a Ph.D in Nuclear Engineering he was hired as a Chemical Engineer with Pacific Northwest National Labs (PNNL) in Washington State. As a chemical engineer at PNNL, Schwerdt is able to work on an array of projects. While his

main focus is studying plutonium oxide processing, which is very similar to the uranium oxide processing research he did at the University of Utah during his Ph.D. He also works on sol-gel processing and novel fuel development for research reactors. "We get to do a lot of different things in a lot of different technical areas, and the University of Utah really prepared me to do that."

Schwerdt spends the majority of his time at the lab as part of a team that is investigating the nuclear forensic signatures from the processing of plutonium oxides. His graduate research prepared him in the synthesis and analysis of nuclear materials. The tools and skills he developed at the University of Utah allowed him to rapidly contribute on projects that are important to furthering our understanding of forensic signatures.

His career as a Ph.D student in the Department of Civil and Environmental Engineering prepared him for life in the industry. "I was able to take a lot of diverse courses in a lot of different technical areas." Schwerdt stated, "I was able to take classes that focused on my research, as well as, areas of interest." He continued to explain that the variety of courses offered at the University of Utah allowed him to be better prepared for his career noting he is able to maintain technical conversations at a high level with many different professionals at Pacific Northwest National Labs, and across the country.



Faculty Awards

Dr. Pedro Romero

Dr. Pedro Romero, Associate Professor with the Department of Civil and Environmental Engineering, was awarded the Walter J. Emmons Award for best paper presented at the 2019 annual meeting of the Association of Asphalt Paving Technologists. Dr. Romero co-authored the paper, “Balanced Mix Design Sensitivity to Production Tolerance Limits and Binder Source,” with Walaa Mogawer and Alexander Austerman from the University of Massachusetts; consultant Keven Stuart; and Fujie Zhou from the Texas A&M Transportation Institute.



Dr. Ramesh Goel

Dr. Ramesh Goel, Professor in the Department of Civil and Environmental Engineering, was a coresponding author on the paper “The Role of Internal Nutrient Cycling in a Freshwater Shallow Alkaline Lake.” The paper was highlighted as one of the best papers in Environmental Engineering Science Journal in 2019. Mitch Hogsett, a former Ph.D student, first author, Hanyan Li, a current Ph.D student, and Dr. Ramesh Goel’s paper was published by Mary Ann Libert Inc, the official journal of the Association of Environment Engineering Scientists and Professors.

Undergraduate Researcher Spotlight



Ryan Godin

Ryan Godin is a senior majoring in Mechanical Engineering with a minor in Nuclear Engineering. Ryan is working with Dr. Ed Cazalas and 4 others to build a containment facility with the purpose of safely pulling specimens for radioactive detection. This containment unit will limit radioactive exposure and create a safer way to test radioactive material.



Brad Cottle

Brad Cottle is a senior majoring in civil engineering at the University of Utah. Brad is working with Dr. Pedro Romero to create an alternate cementitious material that is based off of Roman architecture and concrete used by the Romans. One of the goals is to determine how the Romans made the concrete and adapt it to fit modern day standards.



Nate Kennington

Nate Kennington is a Junior Civil and Environmental Engineering Major at the U. Nate is working with Dr. Steve Burian and a graduate student to figure out how to remotely collect data from a weather station. Kennington served as the equipment manager for the project and assisted with data collection, ensuring the data was accurate and distributing the information. This project was researching and determining if how much people were watering matched the data transmitted by the sensors placed in the ground.



Civil Engineering Students Awarded more than \$100,000 in Scholarships

The Department of Civil Engineering awarded students \$111,000 in scholarships with an average of \$2,900 per student in the 2019 - 2020 Academic year. Of all the students who applied for scholarships, 60% of were awarded them. In addition to the scholarships awarded by the Department of Civil and Environmental Engineering, the College of Engineering awarded students \$1,582,000 in scholarships.

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