Department of Civil and Environmental Engineering
Cullen College of Engineering

BLUEPRINT

CIVIL & ENVIRONMENTAL ENGINEERING

NGA AWARDS UP TO $2.1 M FOR NCALM GEODESY EXPANSION

Kaspar J. Willam Professor **Hyongki Lee** (PI) and co-PIs Hugh Roy and Lillie Cranz Cullen Distinguished University Chair Professor **Craig Glennie**, Research Associate Professor **Juan Carlos Fernandez Diaz** and Assistant Professor **Surui Xie** have received approval for the first $500,000 of up to $2.1 million over the next five years from the National Geospatial-Intelligence Agency (NGA) to enhance the Geosensing Engineering and Sciences (GSES) graduate program, which is part of the National Center for Airborne Laser Mapping (NCALM) in the Department of Civil and Environmental Engineering.

Geodesy is the science of measuring and understanding the Earth's shape, gravity field, and rotation over time to provide a stable reference frame for positioning, navigation, and Earth system monitoring.

It plays a critical role in everything from autonomous vehicles to aircraft navigation and smartphone operation; geodesy supports modern science and society by enabling sustainable infrastructure, reducing disaster risks, and helping build resilient cities in a rapidly changing world. "Geodesy is a very interdisciplinary field," said Lee et al.

"It connects with many important areas — such as climate science, navigation, hydrology, seismology and space science. Students trained in geodesy can apply their skills to a variety of career paths. We want to build a community of students and researchers who are passionate, well-trained, and ready to help solve real-world problems through geodesy."

Long-term, the team seeks to establish UH as a national and international hub for geodesy education and research, producing technical and scientific leaders as well as broadening participation by involving more Houston students from diverse backgrounds. They also hope to further strengthen partnerships with federal agencies like NGA, NASA, DoD and NOAA by contributing to their missions in Earth observation, navigation, AI and disaster reduction, and believe that geodesy will become a core component of geospatial research and education at UH.

Left to right: *Surui Xie, Juan Carlos Fernandez Diaz, Hyongki Lee and Craig Glennie*

CULLEN RESEARCH IMPACTS NATIONAL CODE PROVISIONS AND STANDARDS FOR HIGH STRENGTH STEEL REINFORCEMENT

Dimitrios Kalliontzis is an assistant professor in the Civil and Environmental Engineering Department and the mentor of the Structural Performance & Fluid-Structure Interaction (SP-I) LAB. He said that after significant work in UH's structures lab and rapid dissemination of findings to committee meetings and national conventions, his group's proposal to permit the use of high-strength steel bars was approved by the TMS 402/602 Main Committee.

According to Kalliontzis, this code change would be the biggest for the current code cycle for TMS 402/602 Building Code Requirements and Specification for Masonry Structures. The code change concerns the first step toward a broader adoption of high-strength steel, a market that has grown from $29.6 billion in 2019 to $44.2 billion in 2024.

Research findings from Kalliontzis' group showed that the adoption of high-strength steel bars can reduce reinforcing material costs by up to 25 percent with a corresponding reduction of carbon footprint of 33 percent in masonry buildings.

"This code adoption opens a new door for the masonry industry to modernize its construction practices by adapting to contemporary steel materials that are becoming more and more prevalent," he said. "As it has been done with Grade 40 bars, it is likely that future construction will slowly abandon Grade 60 bars, making high strength rebars the only available option in the market. Hence, the adoption of high strength rebars is both a requirement for modernization as well as a requirement for survival. And that has been made possible by research performed at the University of Houston."

Kalliontzis said the findings wouldn't have been possible without the help of several of his students — **Omar Khalid**, a Master's degree graduate, and current Ph.D. students **Waleed Khan** and **Samvid Parajuli**. John Hochwalt from the Seattle office of KPFF served as the industry advisor for the team's research.

Dimitrios Kalliontzis
Assistant Professor

LEE SEEKS TO FURTHER EXPAND FLOOD FORECASTING FRAMEWORK

Kaspar J. Willam Professor **Hyongki Lee's** satellite-driven inundation forecasting framework, Forecasting Inundation Extents using REOF (Rotated Empirical Orthogonal Function) (FIER) has received funding from both NASA (for applications in Southeast Asia's Mekong River basin) and NOAA (for applications in the US) as the project seeks to continue expanding into broader use cases around the world.

The framework has been developed with the support of many component projects and partnerships, and multiple funding sources, including the NASA SERVIR program, NOAA JPSS program, and South Korea's K-Water institute, totaling just under $1.3 million thus far.

FIER was originally conceived due, in part, to Lee's own experiences during Hurricane Harvey. It "began as a fluvial flood forecasting tool and has since evolved to forecast compound flooding," including flood scenarios that combine fluvial, pluvial and storm surge components.

"Even in Houston, which is the fourth largest city in the US, we don't have an inundation forecasting system. We only have real-time monitoring systems. That night, when the water level was rising in front of my home, there was no information available other than the water gauges and the real-time flood maps — but even those are limited to simulation," he added.

"After that, I was interested in developing an inundation forecasting system. Traditionally these are developed using the traditional hydrodynamic model, but it requires a lot of input data, and most of the time those datasets are limited. Because my expertise is remote sensing for water applications, I had the idea to extract spatial-temporal flood information from historical satellite imagery data."

This inclusion of historical data enables the model to simulate future inundation risk more effectively. The model was first implemented in the Mekong River basin in Southeast Asia, where forecasting the extent of inundation can make a big difference, for example, in agricultural activity — particularly in the success of rice crops and the estimation of expected economic impact due to damage.

Next, he hopes to take the tool truly worldwide

Hyongki Lee
Professor

RAHIMI RECEIVES AAEES EXCELLENCE IN ENVIRONMENTAL ENGINEERING AND SCIENCE AWARD

Mim Rahimi, an assistant professor in the Civil and Environmental Engineering Department at the Cullen College of Engineering, has received an award in the American Academy of Environmental Engineers & Scientists (AAEES) 2025 Excellence in Environmental Engineering and Science Competition (E3S).

Rahimi's research on "Electrochemical Frontiers in Marine Carbon Dioxide Removal" was recognized with Honor distinction in the University Research category. He received the award on April 10 during an AAEES luncheon hosted by George Washington University, where he also presented his research.

Earlier this academic year, Rahimi was selected for the 2025 cohort of the AAEES' 40 Under 40 Recognition Program. Additionally, he received an NSF CAREER award in February 2024 for his proposal titled "Leveraging Liquid-Liquid Interfaces for Innovative Electrochemical Carbon Capture."

"Our team focuses on developing electrochemical technologies applicable to various environmental challenges," Rahimi said. "I would like to acknowledge the dedication and contributions of our research team, including Ph.D. students Ahmad Hassan, Mohsen Afshari, Prince Aleta, Abdelrahman Refaie and Sheila Shakoorian, as well as research interns Keira Boone and Yuwen Bai."

Rahimi joined the Cullen College of Engineering faculty in 2021. He previously served as a postdoctoral associate at MIT and earned his doctorate in Chemical Engineering from Penn State. More information about his research and potential lab openings can be found on his research website.

Mim Rahimi
Assistant professor

HANADI RIFAI UNVEILS NEW MODEL TO EVALUATE IMPACT OF EXTREME EVENTS AND NATURAL HAZARDS

When you're on a sandy beach or the banks of a river, transformed by rolling waves or slightly still waters, it's likely you're not thinking about what happens just beneath the surface, where dirt and pollution are swirling and traveling through to new destinations.

But **Hanadi Rifai** does. The Moores Professor of Civil and Environmental Engineering and director of the Hurricane Resilience Research Institute, has spent two decades examining Galveston Bay — its tides, currents and how fresh and salty water mix, continually extending the knowledge of predicting water levels, pollution spread and how ecosystems stay balanced.

Now Rifai has created a sophisticated numerical computer model to help scientists and environmental experts understand how water moves in estuaries — places where fresh and saltwater mix. The model is the focus of an article in the journal Environmental Science and Pollution Research. "Models such as this one will be critical for evaluating climate variability and sea level fluctuation impacts on these lifeline systems for coastal communities," reports Rifai, whose work will also guide better decisions to keep water clean, protect wildlife, and prevent flooding and pollution from spreading.

Hanadi Rifai
Professor

GENOVA, CABRERA, HOSKERE EARN RUNNER-UP BEST PAPER AWARD AT ASCE I3CE 2025 FOR INTELLIGENT REPAIR-ROBOTICS BREAKTHROUGH

A doctoral candidate from the University of Houston's Department of Civil and Environmental Engineering has co-authored a transformative study that redefines approaches to assessing earthquake damage using cutting-edge remote sensing technologies.

The findings, now featured in the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, offer valuable perspectives for enhancing disaster response strategies in the wake of the 2023 Turkey-Syria earthquakes.

Brandon Voelker, working closely with his advisor, **Pietro Milillo**, Ph.D., Assistant Professor of Civil and Environmental Engineering at UH, led the Earthquake Engineering Field Investigation Team's (EEFIT) mission remote sensing team. The research utilized Synthetic Aperture Radar (SAR) and high-resolution optical imaging to map the structural damage across the earthquake-impacted regions of southeastern Turkey, providing a rapid, large-scale view of the destruction.

The February 2023 earthquakes wreaked havoc, claiming thousands of lives and devastating infrastructure across the region. Voelker's work underscores the crucial role of remote sensing in facilitating swift damage assessments – a vital component for directing emergency relief and planning recovery efforts.

"Integrating satellite data with direct field observations is a game-changer for disaster response," Voelker said. "It enables teams on the ground to zero in on the most affected areas, ensuring their efforts are both efficient and effective."

In collaboration with an international consortium of researchers, the study harnessed satellite data from the European Space Agency and processed by the NASA's Jet Propulsion Laboratory and the German Aerospace Center, among other sources. The team employed a hybrid approach, blending remote sensing insights with ground-based data to produce detailed, actionable damage maps. These maps proved invaluable for directing field surveyors to a variety of sites, capturing a nuanced picture of the region's resilience and structural challenges.

Left to right: *Pietro Millio, Brandon Voelker, and Vedus Hoskere*

VIPULANANDAN TO RETIRE AFTER FOUR DECADES WITH CULLEN COLLEGE

August 31, 2025, will mark the retirement of Professor of Civil and Environmental Engineering (CEE) **Cumaraswamy "Vipu" Vipulanandan**, placing the capstone on over forty years of service to the Cullen College of Engineering.

Vipulanandan began his career at the University of Houston as an assistant professor after completing his Ph.D. in Civil Engineering at Northwestern University in 1984. He was promoted to associate professor in 1990 and professor in 1995, and he served as CEE department chair from 2001 to 2009. He has served as the Director of the college's Center for Innovative Grouting Materials and Technology (CIGMAT) since 1994, and as Director for the Texas Hurricane Center for Innovative Technology (THC-IT) since 2009.

He was recognized with the Cullen College of Engineering's Young Faculty Research Excellence Award in 1989 and Senior Faculty Research Award in 2002, and in 2005, he received the Fluor Corporation Faculty Excellence Award — the college's highest award at the time.

Vipulanandan's research interests are numerous and diverse; since 1984, he has received over $14.8 million for more than 90 projects for which he served as PI or Co-PI.

"My main focus is to improve all human engineering operations — to make sure everything is safe and durable," he said. "I work on diverse areas to make sure we can do things together to make the human life better in the future."

One major area of focus for Vipulanandan has been highly sensing human made materials, or so-called "smart materials." This focus includes not only inbuilt sensing capabilities for construction materials like cement, but real-time monitoring capabilities to best make use of the data they provide.

His work also extends to geotechnical soils, soil properties, and their improvement with grouts — materials injected into soil to not only increase its strength and durability, but to monitor for changes that might otherwise go undetected — as well as waste-reducing surfactants.

In 42 years, Vipulanandan — or Vipu — has graduated 36 Ph.D. students and 90 master's students, all with successful theses. Though he's retiring on paper, he has no plans to slow down after wrapping up his time with the University of Houston.

Cumaraswamy "Vipu" Vipulanandan
Professor

MUDUNURU THRIVING AT PNNL **THANKS TO CEE'S NAKSHATRALA, OTHER LAB MENTORS**

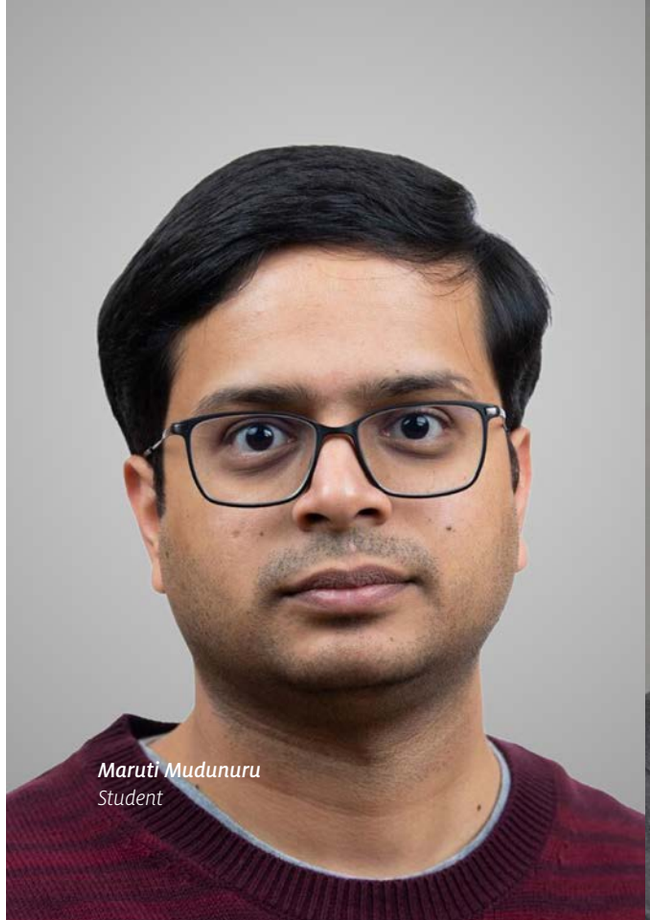
Students come to study at the Cullen College of Engineering for many reasons, but for **Maruti Mudunuru**, there was a specific reason — and a specific person — that caused him to choose the University of Houston.

"Dr. **Kalyana Nakshatrala** [Carl F. Gauss Professor and Associate Chair of Civil and Environmental Engineering] was the primary reason I moved to UH," he said. "I knew I wanted to work under someone with a rigorous and foundational approach to computational mechanics."

He has authorship credits on 15 publications with Nakshatrala, and his dissertation was honored by Cullen professors as one of the year's best in 2015 and earned the Robert J. Melosh Medal for best paper in finite element analysis and computational mechanics in 2016. The medal is co-sponsored by Elsevier and endorsed by International Association of Computational Mechanics.He has authorship credits on 15 publications with Nakshatrala, and his dissertation was honored by Cullen professors as one of the year's best in 2015 and earned the Robert J. Melosh Medal for best paper in finite element analysis and computational mechanics in 2016. The medal is co-sponsored by Elsevier and endorsed by International Association of Computational Mechanics.

"UH research culture and Dr. Nakshatrala's mentorship had a lasting impact on how I think about solving problems. Two things stand out," he said. "First, the importance of mathematical rigor in modeling complex systems. It's easy to rely on simulations, but he taught me to understand every assumption and make sure the math holds up."

Beyond UH, Mudunuru said he still used the fundamental knowledge and learning techniques he picked up along the way.



Maruti Mudunuru
Student

Kalyana Nakshatrala
Professor and Associate Chair of Civil and Environmental Engineering

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