

STEVENS INSTITUTE OF TECHNOLOGY CEOEINAYEAR ANNUAL REPORT 2022



RISING BEYOND EXPECTATIONS EXCELLENCE IN ALL WE DO

CEOE HIGHLIGHTS



ABOUT CIVIL, ENVIRONMENTAL AND OCEAN ENGINEERING

The Department of Civil, Environmental and Ocean Engineering at Stevens (CEOE) is a unique department that covers disciplines usually organized in two or more separate departments. We take advantage of this distinctiveness to benefit our students greatly. Our community of expert faculty and researchers train our students to address the complex cross-disciplinary challenges faced in the design, construction and monitoring of urban/interconnected infrastructure systems, sustainable environmental systems, resilient coastal communities, and marine systems.

Through rigorous and flexible curricula, advanced research programs, and extra-curricular activities, we aspire to give our students the knowledge required to face future challenges in these areas. The combined expertise of our faculty and breadth of research programs provides our students with unique opportunities to acquire knowledge across the three disciplines and build capability to address complex cross-disciplinary problems.

Our mission:

- Provide students with vibrant and diverse degree programs built upon rigorous course offerings, hands-on experience, and opportunities for professional development.
- Instill creativity and innovation in the drive of our graduates to solve real-world problems.
- Perform discovery research to address future challenges.
- Set our graduates on the path to become leaders in their fields.

RISING BEYOND EXPECTATIONS: EXCELLENCE IN ALL WE DO Muhammad Hajj, CEOE Chair and Geo

Muhammad Hajj, CEOE Chair and George Meade Bond Chair

Our department always had strong and special attributes. Still, the past four years have confirmed its ability to rise beyond expectations despite the extraordinary challenges posed by the pandemic. We were able to do it through the unwavering commitment of our faculty and staff to instill excellence in all we do, the support from our alums and industry sponsors, and the hard work of our students.

Over the past four years, we have expanded our research capabilities by renovating and establishing new computational and experimental laboratories including the Subsurface Energy, Water, and Environmental Systems Laboratory, the Smart Infrastructure Laboratory, the Advanced Concrete Technology Laboratory, and the Integrated Spatial Modeling And Remote Sensing Technologies Laboratory.

Our three-year average research funding increased from an average of \$6.14M/year between 2016 and 2018 to more than \$8.8M/year (>\$500K per TT faculty per year) between 2019 and 2022. We are writing three times the number of journal articles (more than 100 in total and more than five per TT faculty member per year), and we are advising twice the number of PhD students (four students per TT faculty member) in comparison to 2018.

Last year, we taught more credit hours with the same number of faculty and with 67% of the number of adjunct faculty we had in 2018. This efficiency has led us to excel in teaching. More than half of our faculty scored 4.75 (out of 5) or higher in student evaluations. None of them scored below 3.0 and more than half of our adjuncts scored 4.75 or higher.

Approximately 45% of our undergraduate students participated in a co-op program last year. Others participated in undergraduate research experience and attended scientific conferences. Our graduate students are participating in more conferences and in summer internships in industry or national labs. Many of our students won prestigious awards.

To the alums, I met many of you over the past four years and realized why you come back to support us in different ways. I am hopeful to meet other alums in the future to seek their advice and support.

To our industry sponsors, thank you for all the support. We could not do as well without your commitment and we look forward to continuing our working relation.

Our future is bright. Our undergraduate civil, environmental and naval degree programs passed the ABET review and are accredited for six more years starting in Fall 2022. We welcomed more than 70 new undergraduate students in Fall 2022. We are proud that 47% of this incoming class are female students. Almost 50% of this class are from outof-state pointing that our strong reputation is expanding further geographically. We also welcomed more than 80 new master's and 18 new PhD students. It was a pleasure meeting many of the new undergraduate and graduate students individually. I look forward to ensuring that they are provided with the best learning experiences, and to achieving new milestones with all of them.

EXCELLENCE

- Leslie Brunell received the 2022 NJ ASCE Educator of the Year award, a testament and recognition to her substantial contributions to education in the field of civil engineering.
- **10 out of 19** tenure track and teaching faculty members who taught in the fall 2021 semester scored above 4.75 (out of 5) in student evaluations. Many others scored above 4.5.
- **Dibyendu Sarkar** received the Stevens 2022 Award for Research Excellence in recognition for his transformative contributions to the field of environmental sustainability.
- **Raju Datla** was elected as a SNAME Fellow, a distinction earned on the basis of his outstanding contributions to the fields of naval architecture, and marine and ocean engineering.
- 7 out of 11 adjunct faculty members scored more than 4.75 (out of 5) in student evaluations in the fall 2021 semester.
- The research project titled "Design of a 100 kW Floating oscillating surge wave energy converter (FOSWEC) – PI: Muhammad Hajj" was identified as a success project in the WPTO's 2020–2021 Accomplishments Report.

STAFF

• Elizabeth O'Connell received the Academic Advisor of the Year award. This award is presented to a faculty advisor or academic advisor who is seen as the best at helping students achieve academic success. It is voted upon by the student body and presented by the Office of Student Affairs.



CEOE BY THE NUMBERS

		Resea
3 YEAR AVEARGE	\$M/YEAR	\$10.00
		\$9.00
2016-2018	\$6.14	00.82
2017-2019	\$5.67	\$0.00
2018-2020	\$8.30	\$7.00
2019-2021	\$7.56	\$6.00
2020-2022	\$8.81	\$5.00
		2018



- Per year research funding (based on 3-year average) increased by 41% between 2016 and 2022
- Three-year average is at an all-time high in 2022
- CEOE should be able to maintain a three-year average of at least \$8 million in generated research funding for the foreseeable future
- On average, the generated research per T/TT faculty member is > \$500K per year

RESEARCH EXPENDITURES IN \$M / YEAR		
2018	\$5.98	
2019	\$5.94	
2020	\$6.09	
2021	\$7.62	
2022	\$8.64	



• Research expenditures increased by about 45% since 2018

• Research expeditures perT/TT faculty member over \$500K pyear

PUBLISHED JOURNAL ARTICLES		
2018	43	
2019	42	
2020	62	
2021	72	
2022	105	



- Number of journal articles published by CEOE faculty increased by about 150% since 2018
- Number of journal articles per T/TT faculty member is > 5.

NUMBER UNDERGRADUATE STUDENTS		
2018	249	
2019	243	
2020	223	
2021	247	
2022	261	





- Number of undergraduate students in 2022 is at a five-year high
- Number of undergraduate students perT/TT faculty member is ~16

NUMBER MASTER STUDENTS		
2018	258	
2019	225	
2020	172	
2021	152	
2022	215	



- The department maintains strong master's degree programs.
- The downward trend caused by the pandemic has been reversed.

NUMBER PHD STUDENTS		
2018	36	
2019	44	
2020	44	
2021	59	
2022	66	



- Number of PhD students has increased by about 84% since 2017
- Number of advised PhD students per T/TT faculty member is 3.9
- CEOE's PhD graduation numbers remain low but should increase significantly starting in AY 22-23

NEW FACULTY & STAFF

Karim Karam joined CEOE as a Teaching Associate Professor in September 2022, having been a Lecturer since August 2021. His teaching interests lie in the planning, design and construction of sustainable infrastructure systems, and the impacts these systems have on our natural environment.

Ronghuan Xu joined CEOE as a lecturer in September 2022. She plans to teach reinforced concrete design, earth support structures, steel design, structural dynamics, finite element method, earthquake engineering etc. Ronghuan's research is mainly focused on studying the seismic performance of structures.

Tina Song joined the department last year as the Research Project Manager of the Davidson Laboratory.

Rita Alvarado joined the department as the Graduate Academic Advisor.

MAJOR SCHOLARSHIP RECIPIENTS

- Construction Industry Advancement Program (CIAP) of NJ awarded 10 undergraduate students scholarships and guaranteed summer internships.
 - Amanda Beltre, Schiavone
 - Angelina Dresser, Skanska
 - Julia Dresser, Port Authority
 - Hans Drexler-Rivero, Keller
 - Anthony Esposito, Atlantic Infrared
 - David Hernandez-Guiro, Skanska
 - John Oliveira, Northeast Remsco
 - Joseph Pastor, RE Pierson
 - Nicholas Pepe, Hall Construction
 - Joshua Sentile, E & LP
- American Council of Engineering Companies (ACEC) New Jersey awarded 5 undergraduate students scholarships:
 - Angelina Dresser
 - Emily Leiby
 - Victor Mavricos
 - Anthony Mendo
 - Fernando Morales
- Adrian Castellanos (undergraduate), Yanqing Liang (undergraduate), and Taylor Danson (graduate) will receive the ASCE 2022 North Jersey Branch Scholarships.
- Erika Vargas and Morgan Westerby received the 2022 Moles scholarships in the amount of \$12,000 each on the basis of their excellent academic achievements. Both Erika and Morgan are participants in the co-op program and are actively involved on campus through ASCE and the athletics program.
- Sustainability Management MS/MS-MBA students, Rexford Anderson and Lojin El Didi, and a Green Engineering minor student, Emily McCormick won the \$2,000 Charlie Bartsch Scholarship from the Brownfields Coalition of the Northeast (BCONE) for developing a Green Street Plan for an underserved community in Newark, New Jersey. This project was part of class deliverables in the Perspectives of Environmental Management (EN510/SM510) course taught by Dr. Dibs Sarkar in Fall 2021.





Muhammad Hajj



George Korfiatis



Mohammed Ilbeigi



IMPACT

Muhammad Hajj, Department Chair and Director of the Davidson Laboratory testified on the potential of ocean wave energy as a renewable energy resource in front of the NJ Assembly Special Committee on Infrastructure and Natural Resources on March 17th, 2022. He was the first speaker from a list that included Eco Wave Power CEO Inna Braverman, Ocean Power Technologies President & CEO Philipp Stratmann, CalWave CEO Marcus Lehmann, and New Jersey League of Conservation Campaigns Director Patty Cronheim.

In his testimony, Dr. Hajj stressed the high energy density of wave power and its advantage in terms of space use over wind and solar power: "To give you an idea, ... 9 meters per second wind gives you 470 watts per square meter. In comparison, a one-meter-high wave with a period of 10 seconds gives ten times as much power, 4900 watts per meter width. This is significant because one meter width of a one-meter-high wave, even if the efficiency is 25%, could power a household based on a yearly average. New Jersey actually has 10,000 watts per meter right on the shore." Professor Hajj also noted that "wind and solar farms take a lot of space... they need up to 50 times the space that is required for coal and 100 times the space that is required for fossil fuels, and this has been an impediment, because land is needed for agriculture and other things. Wave power could address this problem."

Beyond powering the grid, Dr. Hajj noted that "wave power can be used to power remote islands and remote communities – it takes a lot of power to transport fossil fuels and power, we could do this directly with wave power- Wave power could be used for building more resilient coastal communities and desalination, can you imagine having water and energy at the same place and the same time? You could do a lot with that technology..." An audio of the full hearing is available *here*. Dr. Hajj's testimony starts around the 5:00 minute mark.

Members of the Special Committee on Infrastructure and Natural Resources of the NJ Assembly toured the wave tank facility of the Davidson Laboratory on May 31. This facility continues to play a major role in the naval research sector and particularly in the development of marine energy industry by supporting innovative ocean energy technologies and devices for marine systems.

Jen Becker and Favio German from NJ Economic Development Authority visited the Davidson Lab on June 7 to learn more of the lab's capabilities in support of offshore wind energy industry and particularly in providing the education for this industry's workforce. Davidson Lab alumna Dr. Alicia Mahon, Offshore Wind and Ocean Dynamics Team Leader at PNNL attended the meeting.

Three graduate and three undergraduate students were selected to participate in a NASA field campaign to validate and calibrate satellite retrievals of soil moisture from NASA SMAP sensor. The effort was coordinated by Dr. Marouane Temimi and supported by NASA Jet Propulsion Laboratory (JPL). The students worked with scientists from US Department of Agriculture (USDA) and NASA JPL. They were introduced to the fundamentals of soil moisture remote sensing and in situ sampling. The joint work resulted in two publications about the topic authored and co-authored by participating students.

George Korfiatis and Mohammad Ilbeigi, in collaboration with Carlo Lipizzi of the School of Systems and Enterprises, won first place in the 'Financing a Sustainable Future' category of the prestigious SIEMENS Tech for Sustainability Challenge. Their entry titled 'GREEN-CONNECT' establishes an AI based electronic platform designed to connect sustainability related ideas and projects to funding sources and instruments. Stevens team is currently working with SIEMENS on the development of a prototype for this platform. **Reza Marsooli** was featured on PBS/NHK in a docuseries about the impact of climate change and aging infrastructure on flooding in New York City and Hoboken. The episode also featured New Jersey Gov. Phil Murphy and Hoboken Mayor Ravi Bhalla.

Reza Marsooli was featured on NPR in a piece about public awareness of climate change and flooding, especially in communities that are projected to see the biggest impacts in the future. The story was syndicated in 38 states across the US.

Marouane Temimi is spearheading Stevens' research within a national consortium, funded by NOAA, to improve the nation's ability to predict water-related hazards and effectively manage water resources. The federal government has pledged \$360 million over the next five years to support the Cooperative Institute for Research to Operations in Hydrology (CIROH), of which Stevens is a member. Dr. Temimi and his team will advance research in cold regions hydrology as well as street-scale flood inundation mapping in urban areas.

Marouane Temimi and Muhammad Hajj will participate in an exercise organized by the Port Authority on preparedness, response, and recovery capabilities in the face of coastal storms or hurricanes impacting the region. The exercise is based on a Category 3 fictitious hurricane "Thompson" with parameters set by the National Weather Service and that would impact the region. Drs. Temimi and Hajj will provide details of SFAS forecast and predictions in support of decision making.

Marouane Temimi initiated and established a partnership agreement with FEMA that allows Stevens to become one of the agency's cooperating technical partners. The agreement encourages and formalizes greater cooperation in the flood hazard identification, assessment, and mapping processes and strengthens the role that the Davidson Laboratory is playing regionally in this field.

Marouane Temimi was invited by the UAE National Center of Meteorology to participate in a workshop on weather modeling. In his talk, Dr. Temimi proposed future developments and needs to enhance UAE's water resources.

At least 8% of global CO2 emissions caused by humans come from the cement industry alone and its production must be decarbonized. **Weina Meng** is addressing this matter by developing "low carbon concrete" along two pathways. The first is by replacing the cement with high volume of waste materials and the second by sequestering CO2 in concrete by permanently locking CO2 into concrete through exposing the waste materials to CO2 and producing CaCO3. The research products will be implemented for new construction and repair of bridge deck overlays in New Jersey and New York.

The Integrated Spatial Modeling And Remote Sensing Technologies Laboratory (I-SMART) hosted undergraduate students supported by the I&E Summer Scholars Program and The Pinnacle and Clark Scholars Program in summer 2022. These students were introduced to the use of satellite data in management of water resources management. The students participated in NJDEP's 34th Annual GIS Mapping Contest on monitoring drought in New Jersey.

David A. Vaccari was elected to the succession as the President of the American Academy of Environmental Engineers and Scientists in June 2022. In that role, he will have general supervision over all affairs and operations of the Academy. AAEES is a not-for-profit organization serving the Environmental Engineering and Environmental Science (EES) professions with a mission to promote continual improvement in environmental engineering and science education and practice.



Reza Marsooli



Marouane Temimi



Weina Meng



David A. Vaccari





Alaa Ahmed



Mohamed Abdelkader



Erfan Amini



Pooya Dastpak and Shengfeng Huang



Jiang Du and Pengwei Guo



Yuntian Teng



GRADUATE EXCELLENCE

Alaa Ahmed was selected to receive the prestigious Link Foundation Ocean Engineering and Instrumentation Fellowship in the amount of \$34,000 for the 2022-2023 academic year. Alaa's research is focused on evaluating multi-fidelity approaches to support estimating wave power capture, PTO loads, and LCOE at full scale. She is also developing a state-space model for implementation of active control strategies for maximum power generation. Alaa is validating all simulations and results with wave tank experiments. She is advised by Dr. Muhammad Hajj.

Mohamed Abdelkader received a fellowship to participate in the summer institute held at the NOAA National Water Center in Tuscaloosa, Alabama. The Summer Institute, a six-week program, provides a unique opportunity to collaborate with national leaders in hydrology, modeling, and decision support, and with top graduate students in the field. He is advised by Dr. Marouane Temimi.

Mohamed Abdelkader received a fellowship from the FAIR Cyber Training (FACT) project that is funded by the NSF to train students to analyze geoscience related data, develop computational workflows, use high performance computing (HPC) for scientific simulations and publish digital products following the best practices in Findable, Accessible, Interoperable, and Reusable (FAIR) science. Mohamed will be working on a project entitled "Integrating Ground-based Measurement, Satellite observations. and Numerical models for the Monitoring of hydroclimatological Processes over the US Northeast Coast". He is advised by Dr. Marouane Temimi.

Mohamed Abdelkader received a travel grant to participate in the 2022 Frontiers in Hydrology Meeting (FIHM), 19-24 June 2022, in San Juan, Puerto Rico. He gave two oral presentations entitled "Analysis of the temporal variability of SMAP soil moisture accuracy in a forest site, in Millbrook, New York" and "Assessment of the performance of the National Water Model using multi-decade retrospective simulations across the Contiguous United States". He is advised by Dr. Marouane Temimi.

Erfan Amini was selected as a 2022 Waterfront Scholar to attend the Waterfront Alliance's annual Waterfront Conference. The conference, held May 24 in New York City, focused on redesigning communities, enhancing their ability to adapt to conditions that are becoming a "new normal" and to recover from climate impacts in a resilient manner. Erfan's PhD research focuses on the benefits of green infrastructure for mitigation of flood hazards. He is advised by Dr. Reza Marsooli.

Pooya Dastpak and Shengfeng Huang received the 2021-2022 ASCE Geo-Institute Metropolitan Section Chapter Scholarship. Pooya's research focuses on the study of the mechanics of internal soil erosion due to defective pipes and sinkhole occurrence. He is collaborating on projects related to the application of machine learning to tunneling automation. Shengfeng's research focuses on the detailed analysis of hazards along the planned \$12.3B Hudson tunnel and on tunnelling automation. They are advised by Dr. Rita Sousa.

Jiang Du and Pengwei Guo were invited for 2022 Spring American Concrete Institute (ACI) Convention to present their research work on implementing machine learning for real-time assessment of plastic viscosity of ultra-high-performance concrete. They are advised by Dr. Weina Meng.

Yuntian Teng received a summer internship supported by the Ingenuity program in the Earth & Environmental Sciences Area (EESA) at the Lawrence Berkeley National Lab (LBNL). This program is focused on cultivating a diverse, talented next-generation workforce in the field of geologic nuclear waste disposal. Yuntian is working on development of advanced understanding of energy flows in swelling clays with a focus on using experimental and theoretical tools to understand the role of temperature on the threshold pressure gradient of non-Darcian flow in low-permeability clay. He is advised by Dr. Cheng Chen.

Sameer Neve received the graduate scholarship award of the ASCE North Jersey Branch. Sameer also received the second prize in the student research competition in the 37th Annual International Conference on Soils, Sediments, Water and Energy organized by the Association for Environmental Health and Sciences for his poster titled "Reusing a plant waste for environmental remediation: Vetiver root biochar adsorbs copper". He is advised by Dr. Dibs Sarkar

Viravid 'Gunn' Na Nagara received the first prize in the poster presentation competition for his presentation titled "Pollutant removal from stormwater retention ponds by a simulated floating treatment platform: Greenhouse study" in the 107th Annual Conference of the New Jersey Water Environment Association. Gunn graduated with a PhD in Environmental Engineering in Spring 2022. His advisor is Dr. Dibs Sarkar.

Achraf Tounsi received a Travel Grant Award to HydroML Symposium that was hosted at Penn State between May 18, 2022 – May 20, 2022. Achraf presented his work on the use of machine learning for streamflow forecast. He is advised by Dr. Marouane Temimi.

Achraf Tounsi received support a travel grant award from the American Meteorological Society (AMS) to attend the 25th conference on satellite meteorology, oceanography, and climate in Madison, Wisconsin. He is advised by Dr. Marouane Temimi.

UNDERGRADUATE EXCELLENCE

ASCE's 2022 New Collegiate Faces included **Yanqing Liang**, a 2022 Civil Engineering graduate. These students are chosen based on their academic accomplishments, commitment to serving others, communication skills, and industry involvement. This was the first time a Stevens student received this prestigious honor from ASCE.

Senior design multi-disciplinary team (Aidan McEnroe and Evan Headley (Naval Engineering), and Tyler Sapp and Nicholas Beja (Mechanical Engineering), supervised by Dr. Raju Datla, secured second place in ASNE's Promoting Electric Propulsion (PEP) competition – Unmanned division.

CEOE Senior Design team (Leah Ryan, Yanqing Liang, Emily Ng (Engineering Management), Garrett Horwath, Tanner Chiampraser and Jordan Balgahoom), supervised by Dr. Leslie Brunell, and under professional mentorship by Gregg Woodruff, P.P, Mark Villamar, Joe Caulfield, Miguel Peralta, received the Best CEOE Senior Design Award for their "1200 Madison Street Stormwater Management Project." The team worked on the revitalization of this abandoned facility into a mixed-used retail and residential building with a footprint of approximately 4 acres. The design team worked alongside property owners Pegasus Partners, LLC, who sponsored the senior design project, and Langan Engineering to propose a stormwater management design that focuses on stormwater quantity and quality. Sustainability and innovation guided the proposed design, with implementation of green roof systems, bioretention planters, and subsurface detention to store approximately 400,000 gallons of stormwater and to discharge to the Northwest Park across the street.

Environmental Senior Design Team (Shea Bontempo, Katie Foster, Cielo Abe, Keely Coval) supervised by Dr. Xiaoguang Meng placed second in the Ansary Entrepreneurship Competition. The team developed a cutting-edge filtration method for lead removal that is accessible and affordable to all. They enhanced an activated carbon filter with Titanium Dioxide solution, which is highly efficient at lead and heavy metal removal. Lead contamination in drinking water is a major issue as lead accumulates in the body over time and has adverse health effects, especially in children.

Eleven senior design projects were sponsored and supported by WSP-USA, Thornton Tomasetti, Jacobs Engineering, CLS Project Solutions, Pegasus Partners, Langan Engineering, Kimley-Horn, the Lake Hopatcong Museum, Naval Engineering Education Consortium, the Deptartment of Energy, and the American Society of Naval Engineers. CEOE faculty and students are very appreciative of this support.



Sameer Neve



Viravid 'Gunn' Na Nagara



Achraf Tounsi



Yanqing Liang



Emily Leiby



Morgan Westerby

