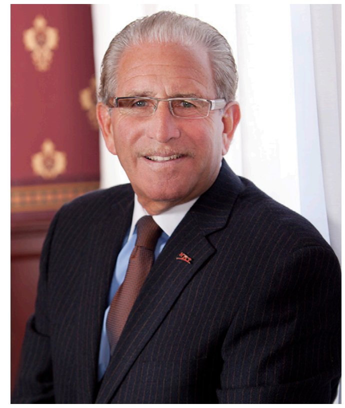
FACULTY RESEARCH SHOWCASE

Monday, November 15, 2021

NJIT
New Jersey Institute of Technology

The President's Forum



As one of only 32 polytechnic universities in the United States, NJIT fills a crucial role in a world shaped by technological innovation. The major industries that drive our global economy are technology enterprises at their core, and they rely on scientific breakthroughs and technological innovations to enhance their efficiency and to deliver next-generation solutions to longstanding and emerging needs.

In addition to preparing a highly diverse and exceptionally accomplished student body to become the science, technology, engineering and math (STEM) workforce that shapes our economy, NJIT is an elite research university. We now conduct more than $155 million in applied research annually, solving real-world problems in areas that include civil infrastructure, advanced manufacturing, cybersecurity, transportation, medical devices, clean energy, national defense, health care and many others.

The growth of our research portfolio has earned us the distinction of being designated an "R1" research university by the Carnegie Classification®, which indicates the highest level of research activity. NJIT is one of only 131 universities nationally and just three in New Jersey — Princeton and Rutgers are the others — to achieve this recognition.

The Faculty Research Showcase offers an overview of the future of research at NJIT, with presentations that introduce our newest faculty and their impressive work to NJIT's research community, in addition to seed grant posters that illustrate the ideas and innovations being produced by new and long-standing members of the NJIT community. Faculty seed grants represent NJIT's commitment to supporting promising research with funding that enables development of a concept into a proposal that can attract significant external resources from the National Science Foundation and the National Institutes of Health, as well as other agencies and foundations.

This year, the showcase is combined with another timely event put on by the new NJIT chapter of the National Academy of Inventors. In two panel discussions, scholars from NJIT and distinguished guests from Rutgers University, Princeton University, the University of Buffalo and the New Jersey Commission on Science, Innovation and Technology will discuss global approaches for managing climate change and innovations that will advance them. Karen Reif, the vice president for renewables and energy solutions at PSE&G, will give the keynote address.

This day allows us to celebrate the exceptional research and innovation occurring at NJIT while demonstrating the extraordinary ability of our faculty and the importance of their work in improving our world and our lives.

Joel S. Bloom
President of NJIT

Transforming the Research Enterprise at NJIT

Over the past four decades, NJIT has evolved from a commuter school teaching applied engineering skills into a globally ranked public research university. In 1979, our research expenditures totaled $375,000; today they surpass $155 million. In 2019, NJIT joined the top tier of research universities in the country — and one of just three in the state — with a designation of R1 by the Carnegie Classification®, a category indicating "very high research activity."

Developing knowledge and applying it to the benefit of society requires talent, substance and resources. We are actively recruiting, developing, supporting and retaining an exceptional faculty, and are continually striving to provide the environment necessary for success from the moment of their appointment to the peak of our scholars' academic careers. We aim to break down barriers to multidisciplinary collaborations as contemporary research demands it. We value entrepreneurial research, promote our inventions and facilitate technology transfer. Nine NJIT faculty members so far have been named Fellows of the National Academy of Inventors.

Our ambitions as a research institution are nowhere more apparent than in our people. Since 2012, we have hired about 20 new faculty members every year as we deepen our capabilities across STEM and other disciplines. They include experts on topics such as machine learning, data analytics, biomaterials and biomechanics. These enterprising scholars bring us not only original research and cutting-edge investigative methods from the country's top academic institutions, but an energizing diversity that renews our traditional disciplines and broadens our research scope. Over the past five years, 15 young researchers have won CAREER awards from the National Science Foundation.

So it is with enormous pride that NJIT showcases its growing research talent in the Eighth Faculty Research Showcase. Some of the presentations you will hear today represent interdisciplinary collaborations brought to life on campus with seed funding from an NJIT research program designed to tackle problems that represent the university's core strengths in fields such as the life sciences and health care, sustainable systems and data science. They bridge disciplines as distinct as physics and design. Our approximately 130 research hubs, including institutes, centers and laboratories, are designed to inspire many more productive partnerships.

We will also measure the impact of our ambitious transformation from multiple perspectives. Critically, we will assess our success in materially improving lives both in our immediate region and in communities across the globe that benefit from the technology we develop and effectively deploy. Just as importantly, we will judge our achievement by the number of technology innovators we nurture in our undergraduate and graduate programs, exposing them to high-level research and real-world applications, so they are empowered to confidently take on the problems of tomorrow.

Fadi-Pierre Deek

Fadi P. Deek
Provost and Senior Executive Vice President

Program

National Academy of Inventors - NJIT Chapter Workshop

Sustainable Societies and Climate Change: The Quest for Sustainable Global Solutions

In conjunction with

President's Forum
and
NJIT's 2021 Faculty Research Showcase

Sponsored by:
National Academy of Inventors
NJIT Office of Research
Carbon Group Global
N.J. Commission on Science, Innovation and Technology

November 15, 2021: Ballroom, Campus Center, NJIT

NAI-NJIT Chapter Workshop: 10:00 a.m. – 12.30 p.m.
Lunch and Networking: 12:30 p.m. – 1:00 p.m.
NJIT Faculty Research Showcase: 1:00 p.m. – 3:00 p.m.

YouTube Live Streaming at https://youtu.be/6glZj1hhWkw

Climate change is no longer a distant apocalypse, but an emerging reality experienced on the ground by regions around the globe. The recent spate of natural disasters — from forest fires, to searing temperatures, to drought, to hurricanes — injects urgency into the search for sophisticated data, near-term technological solutions and strategies for coping in an altered world. Indeed, as the Intergovernmental Panel on Climate Change noted, "Many of the changes observed in the climate are unprecedented in thousands, if not hundreds of thousands of years, and some of the changes already set in motion — such as continued sea level rise — are irreversible over hundreds to thousands of years."

Sustained reductions in the emission of greenhouse gases are a top strategic priority that will require the involvement of communities around the globe and the participation of problem-focused partnerships among academia, industry, government and private and nonprofit policy advocates. Societal gaps in knowledge about the severity and implications of climate change within individual countries and the political will to undertake coordinated global policies present real challenges.

This event is a part of the NAI-NJIT Chapter Workshop Series on "Innovations to Global Solutions," and the President's Forum is a featured event in the Albert Dorman Honors College Colloquium Series and is made possible in part by the generous support of the DeCaprio Family.

NAI-NJIT Workshop Program

10:00 a.m. – 10:05 a.m.: Welcome Remarks

Joel S. Bloom, *President, NJIT*
Upendra Chivukula, *Commissioner, New Jersey Board of Public Utilities*
Fadi P. Deek, *Provost and Senior Executive Vice President, NJIT*
Atam Dhawan, *Senior Vice Provost for Research, NJIT*

10:05 a.m. – 10:35 a.m.: Distinguished Keynote Presentation

Distinguished Speaker: Karen Reif, *Vice President, Renewables and Energy Solutions, PSE&G*

10:35 a.m. – 11:25 a.m.: Distinguished Panel Discussion:
Climate Change: Global Challenge and the Quest for Sustainable Solutions

Moderator:
Govi Rao, *President and CEO, Carbon Group Global*

Panelists:
Robin Leichenko, *Co-Director, Rutgers Climate Institute and Professor, Department of Geography*

Elie Bou-Zeid, *Director, the Metropolis Project at Princeton University, and Professor, Department of Civil and Environmental Engineering*

D. Scott Mackay, *Professor and Chair, Department of Geography at the University of Buffalo, Professor, Department of Environment and Sustainability*

Judith Sheft, *Executive Director, New Jersey Commission on Science, Innovation and Technology*

11:25 a.m. – 12:00 p.m.: Distinguished Panel Discussion:
Environment Sustainability: Innovations to Sustainable Global Solutions

Moderator:
Atam Dhawan, *Senior Vice Provost for Research, NJIT*

Panelists:
Pallavi Madakasira, *Director, Clean Energy, New Jersey Economic Development Authority*

Michel Boufadel, *Director, Center for Natural Resources at NJIT and Distinguished Professor, Department of Civil and Environmental Engineering*

Xiaonan (Shannon) Tai, *Assistant Professor, Department of Biological Sciences at NJIT*

Omowunmi "Wunmi" Sadik, *Distinguished Professor and Chair, Department of Chemistry and Environmental Science at NJIT*

12:15 p.m. – 12:30 p.m.: Concluding Remarks:

Distinguished Speaker: Mihri Ozkan, *Professor, Department of Electrical and Computer Engineering, and Climate Champion Faculty, University of California-Riverside; Fellow, National Academy of Inventors (NAI)*

12:30 p.m. – 1:00 p.m.: Lunch and Networking Session

1:00 p.m. – 3:00 p.m.: Faculty Research Showcase: Faculty Presentations

Keynote Speaker

Karen Reif

Vice President - Renewables and Energy Solutions
Public Service Electric & Gas Company

Karen Reif is vice president of Renewables and Energy Solutions at Public Service Enterprise Group, where she oversees PSE&G's clean energy programs. She is responsible for the operations and strategic growth of both PSE&G and PSEG Long Island's solar energy, energy efficiency, demand response and alternative fuel vehicle programs.

As of July 2018, PSE&G has made more than $1.3 billion in solar investments in New Jersey and more than $400 million in energy efficiency programs in the state. PSE&G's current Solar 4 All investment is concentrating on turning landfills and brownfields green by building solar farms on otherwise unusable sites. In addition, the company has announced plans to propose an additional $2.5 billion in energy efficiency programs, $300 million in electric car infrastructure investment and $100 million in battery storage projects.

Previously, she was senior director of continuous improvement for the Shared Services Organization at PSEG and established this function for PSEG, which is responsible for developing sustainable, repeatable and quantifiable business improvements based on industry best practices. She also has worked in the Information Technology Department and in multiple areas of IT focusing on finance, strategy, business relationship, application implementation, quality assurance, process management, and program management. Prior to working in PSEG, Reif was a consultant with Scott, Madden & Associates.

She holds a B.A. in Economics and International Studies from Emory University, as well as an M.B.A. (M.S.I.A.) from Carnegie Mellon University. She has the following certifications: Project Management Professional, Lean Six Sigma and Information Technology Infrastructure Library (ITIL) Foundation.

Speaker Bios

Govi Rao

is the co-founder and managing partner of Carbon Group Global, a company whose mission is to ensure that innovative, proven businesses addressing the world's most urgent social and environmental challenges have access to the resources and support they need to achieve rapid scale. Rao was previously the president and CEO of Noveda Technologies, a pioneer in water and energy management solutions. He serves on several advisory boards, including the Undergraduate Research and Innovation program at NJIT and the Department of Chemistry and Chemical Biology at Rutgers University.

Robin Leichenko, Ph.D.

is a professor of geography at Rutgers University and co-director of the Rutgers Climate Institute. Her current research explores the economic and equity impacts of climate change with a focus on the Northeastern United States. Leichenko serves as co-chair of the fourth New York City Panel on Climate Change, an independent, 20-member advisory body that synthesizes scientific information and advises city policymakers on local resiliency and adaptation strategies. She previously served as a review editor for Working Group II of the *Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.

Elie Bou-Zeid, Ph.D.

is a professor of civil and environmental engineering at Princeton University, where he is also the founding director of Princeton's School of Engineering and Applied Science's Metropolis Project, which brings together a diverse group of investigators to advance urban technological innovations that make cities more sustainable, resilient, livable and equitable. His research is broadly focused on the measurement and modeling of air flow and energy transfer in the lower atmosphere, with applications to urban environmental quality, building energy efficiency, wind energy production and polar sea ice fluctuations.

D. Scott Mackay, Ph.D.

is the chairman of the Department of Geography at the University at Buffalo, The State University of New York and the director of the Ecohydrology Group within the Department of Geography and the Department of Environment and Sustainability. He examines the mechanisms of vegetative stress responses to environmental dynamics, such as drought, elevated temperature and nutrient limitation. His group develops novel biophysical models that assimilate physical and physiological observations to identify emergent traits of plants that are difficult to quantify empirically. He is the editor of the American Geophysical Union journal, *Water Resources Research*.

Judith Sheft

is the executive director of the New Jersey Commission on Science, Innovation and Technology. The commission's mission is to accelerate economic development in New Jersey through science, innovation and technology, including stimulating academic-industrial collaboration and encouraging and supporting entrepreneurs and inventors. Previously, she was involved with regional economic and cluster development, with responsibilities at the New Jersey Innovation Institute @ NJIT for the Health IT Connections entrepreneurial cluster development program, the NJIT I-Corps Site and the Procurement Technical Assistance Center.

Speaker Bios

Atam Dhawan

Atam P. Dhawan is the senior vice provost for research at NJIT, the founder and executive director of the university's Undergraduate Research and Innovation program, the president of the newly established NJIT chapter of the National Academy of Inventors (NAI), an elected Fellow of the NAI and a distinguished professor of electrical and computer engineering. He focuses on medical imaging and analysis, computer-aided diagnoses and point-of-care technologies. He is the inventor, for example, of a device that enables doctors to use light to look beneath the outer layer of the skin to detect diseases such as early-stage skin cancers.

Pallavi Madakasira

is the director of clean energy at the New Jersey Economic Development Authority (NJEDA). She leads the NJEDA's efforts to ensure the state's long-term competitiveness in the clean energy sector. Her principal responsibilities include rolling out grant programs, developing initiatives to create green jobs and serving as NJEDA's relationship manager for key industry stakeholders. Previously, Madakasira directed strategic marketing at Solvay, where she led the creation of new products and business models centered around sustainability. Prior to Solvay, she worked with Lux Research advising Fortune 500 companies on strategies in the field of clean energy technologies.

Michel Boufadel, Ph.D.

is a distinguished professor of civil and environmental engineering at NJIT and the director of the university's Center for Natural Resources. The Center specializes in assessment and remediation studies of pollution in natural settings, and the evaluation of natural resources for potential production of energy, especially renewable energy. Boufadel served recently on two committees of the National Research Council of The National Academies: "An Ecosystem Services Approach to Assessing the Impacts of the Deepwater Horizon Oil Spill in the Gulf of Mexico" and "Effective Daily Recovery Capacity" from oil spills.

Xiaonan (Shannon) Tai, Ph.D.

is an assistant professor of biology at NJIT who joined the university in 2020 from the University of Utah, where she was a postdoctoral fellow at the Global Change & Sustainability Center. Tai works at the boundaries between ecology, hydrology, GIScience, remote sensing and computer science. She studies the underlying geospatial patterns of vegetation dynamics and how they influence the future of ecosystems and water resources amid novel environmental conditions. She recently concluded that the sideways flow of water through soil can have an important impact on how riparian forests respond to climate change.

Omowunmi "Wunmi" Sadik, Ph.D.

is a distinguished professor and chair of the Department of Chemistry and Environmental Science at NJIT. Until 2019, she was the director of The Center for Research in Advanced Sensing Technologies & Environmental Sustainability at Binghamton University. She focuses on surface chemistry, sensors, materials for energy research and the environment. Sadik translated basic research in biosensors into a portable, fully autonomous and remotely operated sensing device known as an Ultra-Sensitive Portable Capillary Sensor. She is the co-founder of the Sustainable Nanotechnology Organization.

Concluding Remarks

Mihri Ozkan, Ph.D.

is a professor in the Department of Electrical and Computer Engineering at the University of California (UC)-Riverside and the Climate Action Champion and Change Maker Professor of the University of California. She is a Fellow of the National Academy of Inventors and of the National Academy of Engineering's Frontiers of Engineering, and an alumna of Keck National Academy of Science. Ozkan completed her graduate studies at Stanford University and at UC-San Diego.

Ozkan's research is sparked by her commitment to climate control and environmental improvement. Her research group has been developing game-changing solutions for Li-ion battery technologies using sustainable materials and green chemistry with low power processing. Transforming waste glass and plastic bottles, biomass (mushrooms, sugar) and natural sources such as sand and diatoms into high-grade battery electrodes is among her group's achievements.

Her creative nature has resulted in 29 granted and 15 active patents in the area of advanced Li-ion battery technologies for smart grid, electric vehicle and portable electronics applications. Her invention portfolio puts her at the level of the most innovative faculty at UC-Riverside; she was selected as one of the "Remarkable Women of UC-Riverside" by the UC Regents. Her creative research and innovative approaches for the advanced Li-ion battery technologies have brought her nearly 56 national and international scientific honors and awards, including the Medal of Engineering Science, Humanitarian Star, Emerging Scholar, Great Inventor, Young Investigator, Achievement in Technical Ingenuity and the Top 100 Science awards, and she has been named as John J. Guarrera Engineering Educator, Top 50 Creator, Climate Global Winner, and Top 100 Author according to the publisher of the science journal, *Nature*.

Ozkan has published 180 journal papers and 155 conference proceedings. She advised and graduated nearly 79 graduate students. Her Google scholar citations are nearly 11062, h-Index is 55 and i10-Index is 140. She has organized symposiums and meetings at the national and international levels. Lately, she is the lead organizer of the Climate Change Mitigation Technologies Symposium at the Fall 2021 Materials Research Society (MRS) meeting in Boston. She is also a guest editor for the *Materials for Carbon Capture* special issue in the 2022 *MRS Bulletin*.

New Faculty

College of Science and Liberal Arts

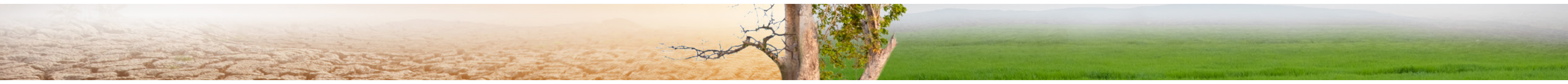
Satoshi Inoue

Assistant Professor of Physics

Satoshi Inoue comes to NJIT from Nagoya University in Japan, where he was an assistant professor in the Institute for Space-Earth Environmental Research. His research area is solar physics with a focus on solar flares and coronal mass ejections, explosions in the Sun's corona that impact Earth's electromagnetic environment. By using numerical simulations of coronal magnetic field and coronal plasma as they evolve in time, he seeks to reveal why and how solar flares are triggered. While conducting experiments at the Kyung Hee University in Korea and later at the Max Planck Institute for Solar System Research in Germany, Inoue developed state-of-the-art simulation methods that take into account magnetic field observations taken by solar instruments. While solar telescopes measure magnetic fields only on the Sun's photosphere, or surface, he numerically extrapolated the three-dimensional magnetic field from the photospheric observations before the flare erupted. He was thus able to show the start of the flare eruption by simulating the initial small perturbation that scientists believe plays a role in converting the stable magnetic field to an unstable one. His simulation allowed direct comparison with the observational data taken during the flare, demonstrating that the nonlinear evolution of the coronal magnetic field is key to the explosion's acceleration. His research at Kyung Hee University and Max Planck Institute for Solar System Research, supported by international scholarship from the Kyung Hee University and the Humboldt Foundation, respectively, led to the publication of a paper in *Nature Communication*s.

Research Abstract

Recent ground-based observations and satellite images show dramatic dynamics observed in the solar corona with unprecedented space and time resolutions. Since the solar corona is filled with magnetized plasma, it is widely considered that the main driver for producing these dynamics is in charge of the magnetic fields. One of the representative phenomena observed in the solar corona is a solar explosive phenomenon called "solar eruptions," which often accompany the solar flare and the coronal mass ejections (CMEs). The purpose of my project is to reveal the onset and dynamics of the solar eruptions and their relationship with the solar flares and CMEs by using computer simulations. Also to note, I perform the simulation combined with observed solar magnetic fields. I will introduce our latest achievements obtained from the data-based simulation.



Niccolo Pescetelli

Assistant Professor of Humanities

Niccolo Pescetelli joins NJIT from the Center for Humans and Machines at the Max Planck Institute for Human Development in Berlin, where he was the principal investigator of the Hybrid Collective Intelligence team. Pescetelli, a cognitive scientist, researches the interaction between artificial and collective intelligence, aiming to understand how technology can facilitate adaptive collective behavior, such as a team reorganizing itself to work remotely, social learning and better group decisions. As a postdoctoral associate at the MIT Media Lab, he worked on hybrid human-machine models of geopolitical forecasting that could help predict election outcomes, for example, as part of an Intelligence Advanced Research Projects Activity grant. His work showed that news recommendation systems affect the collective information gathering and forecasting ability of online groups. Pescetelli likes to engage the public in collective intelligence demonstrations, such as with the BeeMe experiment, a massive online performance where thousands of people controlled him as a real human avatar. The event was covered by the BBC and turned into an award-winning documentary. He has one patent in swarm intelligence. Pescetelli was a Clarendon Scholar at the University of Oxford, where he earned a Ph.D. in experimental psychology that focused on metacognition.

Research Abstract

Many modern interactions happen in a digital space, where automated recommendations and homophily can shape the composition of groups interacting together and the knowledge that groups are able to tap into when operating online. I will present my recent research on online groups showing the impact of common algorithms, such as online search engines on opinion distributions. I talk about designing algorithms that can help groups be smarter. My work aims to shed light on the mechanisms underlying effective collaboration in digital environments. I will highlight the importance of this topic for teams and organizations that use new digital technology to innovate and problem-solve.

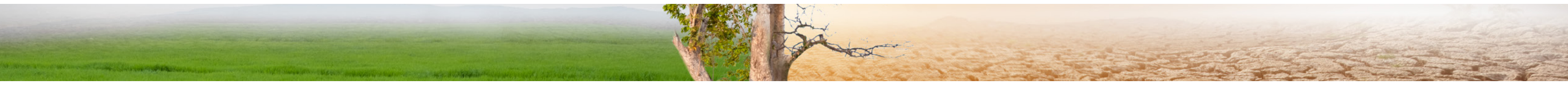
Genoa Warner

Assistant Professor of Chemistry and Environmental Science

Genoa Warner comes to NJIT from the University of Illinois at Urbana-Champaign, where she was a postdoctoral fellow in the Department of Comparative Biosciences. Her research areas are female reproductive toxicology, endocrine disruption and chemical biology. Warner has identified how mixtures of phthalates — chemicals, often called plasticizers, that are found in everyday consumer products — disrupt the function of the ovary in mouse models. The ovary is responsible for fertility and the production of sex steroid hormones; disruption of these processes by environmental chemicals that interfere with the endocrine system can result in infertility and early menopause. As a Ph.D. candidate at Carnegie Mellon University, she designed, prepared and studied the activity of novel oxidation catalysts for the degradation of micropollutants, including endocrine-disrupting chemicals, from wastewater. These iteratively designed catalysts are fully functional small molecular mimics of peroxidase enzymes and are patent pending. She has published in top toxicology and chemistry journals, including *Toxicological Sciences*, *Biology of Reproduction* and *ACS Catalysis*, and is funded by a K99/R00 Career Transition Award from the National Institute of Environmental Health Sciences.

Research Abstract

Endocrine disruptors are chemicals or mixtures of chemicals that interfere with hormones and the endocrine system. Phthalates are a group of endocrine disrupting chemicals used as additives in plastics, medical equipment and personal care products. Humans experience widespread and continuous exposure to multiple phthalates. Although phthalates are known to disrupt both male and female reproductive function, little is known about the toxicity of mixtures of phthalates or their mechanisms of action. The Endocrine Disruption and Chemical Biology Lab (EDC Lab) studies the toxicity and mechanisms of mixtures of phthalates and other endocrine-disrupting chemicals in the ovary, using a mouse model. Understanding the mechanisms through which endocrine disrupting chemicals act can help inform regulators and aid in the design of safer alternative chemicals.



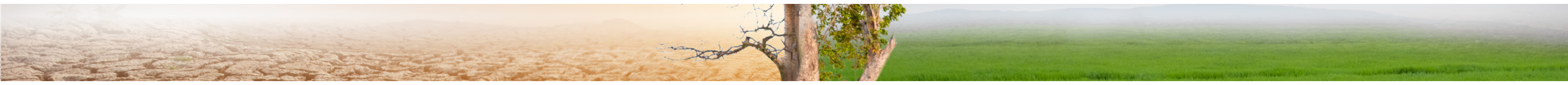
Sara Casado Zapico

Assistant Professor of Chemistry and Environmental Science (Forensic Science)

Sara Zapico joins NJIT from Florida International University, where she was an assistant teaching professor and the graduate program director of the Professional Science Master's in Forensic Science. Previously, she conducted postdoctoral research as a Peter Buck Fellow at the Smithsonian Institution, where she is affiliated as a research collaborator. Zapico explores the application of biochemical techniques to forensic science issues, such as age-at-death estimation and the determination of how long ago a person died. She was the first to demonstrate the correlation between DNA methylation and age in dentin tissue in teeth, leading to better age estimates in forensic anthropology, and, as a result, improvements in the identification of human remains. Additionally, she demonstrated a switch in cellular signaling pathways after death, increasing the accuracy of time-since-death estimations. This latest work earned the Student Scholarship Competition Award from the American Academy of Forensic Science. Zapico is part of the Interpol Disaster Victim Identification Group, Forensic Genetics subgroup, and the American Academy of Forensic Science Standards Board, Disaster Victim Identification Consensus Body. Both agencies try to develop standards for improving identification in disaster situations. She secured an Extraordinary Award in Health Sciences at the University Institute of Oncology of Asturias, where she completed a Ph.D. in biochemistry. She has published in both biomedical and forensic science journals, such as *Epigenetics* and *Science & Justice*, edited two books and has one patent pending.

Research Abstract

Collaborative, interdisciplinary approaches are vital to develop new methods in forensic science that are successful at both advancing knowledge in our field and providing law enforcement labs with practical and reliable techniques. Our research focuses on the application of biochemical techniques, originated in biomedical research, to address forensic science issues and establish new methods for determining age at time of death, accurately estimating postmortem interval, and improving DNA profiling in different situations. This work is an important tool for forensic investigators in contexts where human remains are severely decomposed, such as in mass graves or mass disasters scenarios. This has the potential to increase learning and cooperation across many fields of science.



Lijie Zhang

Assistant Professor of Chemistry and Environmental Science

Lijie Zhang comes to NJIT from Oak Ridge National Laboratory, where she was a postdoctoral research associate in the Environmental Sciences Division and received an "Outstanding Postgraduate" research award for distinguished achievement. Her research interests are biogeochemical and mineralogical processes, with a focus on their impacts in the transport and transformation, or cycling, of environmental pollutants, such as organic contaminants and trace heavy metals. Her research demonstrated the roles of interactions between naturally occurring minerals, such as iron oxides and phyllosilicates, and microbes in the biogeochemical cycling of mercury and phosphonates in both engineered and natural systems. This information can be used to develop green and sustainable remediation strategies for environmental problems of soil and water contamination by heavy metals and organic chemicals within the water-energy-food nexus. For example, modified mineral particles with high affinity for heavy metals can be introduced into soil or water to reduce their bioavailability for immobilization. Zhang has published her research in top environmental and geochemistry journals, such as *Environmental Science & Technology* and *Geochimica et Cosmochimica Acta*.

Research Abstract

Over the years, there is increasing attention on the water-food-energy nexus, which is central to sustainability, economic development and environmental protection. This talk will discuss the control of water particulate (mineral, microbe and other) interactions within the water-food-energy nexus, particularly regarding their effects on the biogeochemical transformation of environmental pollutants in both natural and engineered systems, which may impact the security of all three resources. The results highlight the critical role of water-particulate interactions in the bioavailability of mercury, a heavy metal, and the transformation of phosphonates. Future studies will further investigate the underlying mechanisms with the aim of developing environmentally friendly remediation strategies for contamination.

Hillier College of Art and Design

Kelly Hutzell

Associate Professor of Design and Director of the School of Art and Design

Kelly Hutzell joins NJIT from Wentworth Institute of Technology, where she served as director of graduate programs and as an associate professor in the Department of Architecture since 2015. Prior to joining Wentworth, she taught for 10 years as an associate professor at Carnegie Mellon University in both Pittsburgh and Doha, Qatar. Hutzell is a licensed architect in Massachusetts and works as a consultant with the multidisciplinary Boston-based practice OverUnder. Her teaching and scholarship focus on urban transformations, including mapping and design research addressing climate change. At Wentworth, she taught undergraduate and graduate courses, including "Mapping Urbanism," "Applied Research and Design" and "Design as Research," a thesis preparation course focused on issues of urban resilience, sea level rise and carbon neutral development, among other topics. Hutzell has collaborated with architecture and computer science students and faculty to create architectural guidebook apps for the cities of Pittsburgh and Doha. Her research documenting the urban growth and transformation of Pittsburgh was recently published in the book *Imagining the Modern: Architecture and Urbanism of the Pittsburgh Renaissance*. Her research on Doha has been published in the book *Al Manakh: Gulf Continued*, and in *Architectural Design: UAE and the Gulf: Architecture and Urbanism Now*, among other publications. She is currently writing a book about the rapid evolution of contemporary Doha, tentatively titled *Scenes and Speculations from an Emerging City.*

Research Abstract

Kelly Hutzell is an architect and urban designer. Her research focuses on mapping urban transformations, and includes the creation of architecture guidebook apps. In this research presentation, she will share her current work on a book about the rapid evolution of contemporary Doha, tentatively titled *Scenes and Speculations from an Emerging City*.

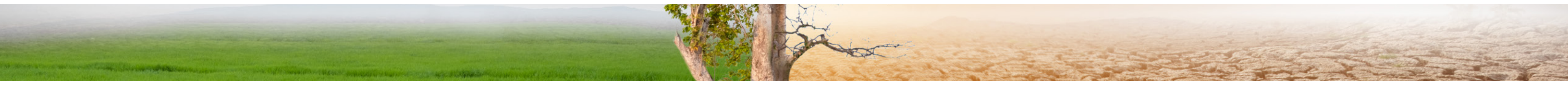
Won Hee Ko

Assistant Professor of Design (Spring 2022)

Won Hee Ko comes to NJIT from the University of California, Berkeley, where she earned a Ph.D. in architecture with a specialization in building science, technology and sustainability. Her dissertation focused on resiliency and integrated analysis of indoor environmental quality for architectural design, which aims to improve occupant comfort, well-being and productivity. The systems to maintain comfortable environments are responsible, however, for roughly one-third of global primary energy use. To address this conflict, Ko concentrates on the building envelope, the physical separator between the indoors and outdoors, and on mitigating various dynamic aspects of the external environment to improve the indoor environment. These factors include the controlled admission of natural light and heat, air quality and visual information of the natural environment. She aims to develop design strategies for the building envelope that simultaneously achieve high levels of indoor environmental quality and energy efficiency in buildings. Ko was recently awarded the P.E.O. (Philanthropic Educational Organization) Scholar Award, given to American and Canadian women doctoral students for their excellence and achievements. She is currently working as a postdoctoral researcher at the Center for the Built Environment (CBE), a research organization where building researchers from Berkeley and over 50 leading industry partners collaborate to produce innovative and application-driven research on buildings. Ko leads research efforts in the building envelope at CBE, and serves as a bridge between scientific research and architectural design practice. She will join NJIT in January 2022.

Research Abstract

My research aims to inform multifaceted and human-centered architectural designs that will improve sustainability and quality of life in urban areas. As humans spend a significant proportion of their lives indoors, it is vital to design buildings that promote positive effects for the occupants. In this presentation, I will share my previous work on environmental autonomy metrics that consider the integrated effect of building performance criteria (i.e., luminosity, temperature and air quality) in creating comfortable and energy-efficient conditions. Also, I will present my current research on view quality and dynamic facades that positively impact humans and the electrical grid. My presentation will end with my future research ideas on healthier and more resilient workplace design using emerging technologies. My work is highly interdisciplinary and collaborative, involving academic experts from various disciplines and stakeholders from institutions and industry. The outcome includes empirical evidence and tools for building design and operation.



Newark College of Engineering

Farid Alisafaei

Assistant Professor of Mechanical and Industrial Engineering

Farid Alisafaei comes to NJIT from the University of Pennsylvania, where he was an NIH-T32 Postdoctoral Fellow and a member of the NSF Science and Technology Center for Engineering Mechanobiology (CEMB). His research focuses on the mechanobiology of cells and tissues, which is an emerging field at the interface of various scientific disciplines, including physics, mathematics, engineering and biology. He develops integrated computational and experimental tools to understand and harness the role of mechanics in physiological processes, such as wound healing and stem cell migration, as well as in pathological processes such as fibrosis, surgical adhesions, scar formation, dry eye disease and cancer progression. Changes in physical properties of the extracellular environment affect many important cellular functions such as migration, proliferation, differentiation and gene expression. Understanding the mechanisms through which cells sense and respond to these physical changes can lead to novel therapeutic modalities and pathways against diseases. Alisafaei showed, for example, that increases in the stiffness of the extracellular environment, due to aging or diseases such as fibrosis or diabetes, enable cancer cells to generate higher forces and become more invasive. He has published his research in top journals, such as the *Proceedings of the National Academy of Sciences*, *Nature Medicine*, *Science Advances* and *ACS Nano*.

Research Abstract

Mechanobiology is a cross-disciplinary field that studies how cell and tissue mechanics interface with physiology and pathophysiology. With the advent of modern biophysical and molecular technologies, this vast field has accumulated volumes of information on different molecular pathways, proteins and biomolecules. The challenge, however, is to find how this endless list of biological information and the staggering amount of experimental data are integrated at the cellular and organismal levels to regulate diverse cellular functions including morphogenesis, migration and proliferation. I will present a theoretical framework that elucidates how different components of a cell work in concert to sense mechanical signals from the extracellular environment and transform them into biochemical responses and mechanical actions. When combined with tightly integrated experiments, the model enables us to understand and harness the role of force and mechanics in physiological processes such as wound healing, and pathological processes such as fibrocontractile diseases and tumor progression.

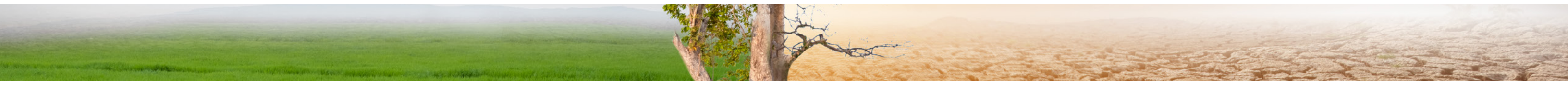
Shaahin Angizi

Assistant Professor of Electrical and Computer Engineering

Shaahin Angizi comes to NJIT from Arizona State University, where he was a research assistant specializing in the design of energy-efficient and high-performance processing-in-memory platforms to enhance a number of functions, such as accelerating complex artificial intelligence and machine learning tasks, bioinformatics computation and graph processing. He studies memory design technology in device, circuit and architecture applications, so-called cross-layer design. He developed a new hardware-friendly algorithm and platform to process DNA data in the memory unit without sending it to the processor for future DNA alignment. The goal of DNA alignment is to check the similarity between DNA short reads and a reference genome that empowers disease diagnostics and other aspects of medical care, including tailored patient treatment and prenatal testing. Angizi has authored and co-authored more than 70 research articles in top-ranked international journals and electronic design automation conferences, such as *IEEE Transactions on Nanotechnology* and *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*. He received the “Best Ph.D.” research award at the Design Automation Conference’s Ph.D. Forum in 2018, two “Best Paper” awards at the IEEE Computer Society Annual Symposium on Very Large-Scale Integration (VLSI) in 2017 and 2018, and a “Best Paper” award at the ACM Great Lakes Symposium on VLSI in 2019.

Research Abstract

In the big data era, the inability of modern computing platforms to deliver both energy-efficient and high-performance computing solutions leads to a gap between meets and needs. Unfortunately, such a gap will keep widening mainly due to limitations in both devices and architectures. First, at the device level, the computing efficiency and performance of CMOS Boolean systems are beginning to stall due to the approaching end of Moore’s law and reaching its power wall. Second, at the architecture level, today’s computers are based on Von Neumann architecture with separate computing and memory units connecting via buses, which leads to a memory wall. Motivated by the aforementioned concerns, in this short presentation, I will discuss cross-layer (device/circuit/architecture/application) co-design of energy-efficient and high-performance processing-in-memory platforms for implementing complex AI and machine learning tasks and bioinformatics tasks, among others.



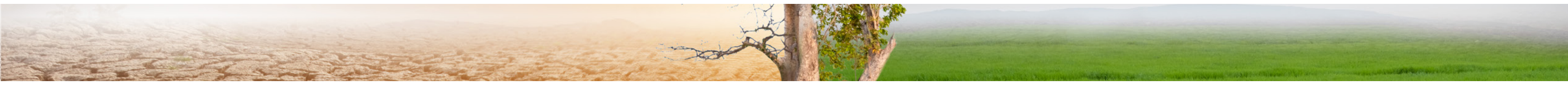
Rayan H. Assaad

Assistant Professor of Civil and Environmental Engineering

Rayan H. Assaad joins NJIT from Missouri University of Science and Technology (Missouri S&T), where he received a Ph.D. in civil engineering. Assaad's research interests include infrastructure asset management of above and underground systems; sustainability, resilience and environmental impacts of infrastructure facilities; computational methods and applied machine learning; and modeling, simulation and optimization of infrastructure and construction operations. At NJIT, he plans to focus on smart cities and intelligent infrastructure systems; modern management techniques, including accelerated project delivery solutions; efficient system performance and innovative facility maintenance, repair and rehabilitation; and next-generation technologies, such as internet of things, construction robots, sensing technologies and virtualization. Assaad previously worked as a project manager responsible for the rehabilitation and maintenance of large commercial and residential projects. His research has been published in more than 32 peer-reviewed journal and conference papers as well as two book chapters. Assaad has received numerous awards for his research, innovations and leadership, including the outstanding reviewer award by the American Society of Civil Engineers' (ASCE) *Journal of Management in Engineering* as well as many awards at Missouri S&T, such as the College of Engineering and Computing Dean's Ph.D. Scholar Award, the distinguished research and innovation excellence award, the leadership award, the key contributor award, the academic excellence award and the scholarship award. Assaad performs services to the profession by being actively involved with the ASCE and the Associated General Contractors of America, among other professional organizations.

Research Abstract

Infrastructure systems and construction facilities, including above-ground structures such as bridges, roads and dams, and underground structures such as utilities, tunnels and subways, are facing considerable challenges, including increasing repair needs, budgetary constraints and uncertainties. Developing innovative, sustainable, resilient and novel solutions to aging and failing infrastructure has become a necessity, especially at a time of worldwide renewal of infrastructure assets for the delivery of required societal services and needs. This presentation provides evidence of how machine learning and next-generation technologies can be used to enhance the planning, design, construction, maintenance and rehabilitation of infrastructure assets throughout their life cycle. Also, modeling, simulation and optimization techniques provide exceptional opportunities for enabling the modernization of large-scale and smart infrastructure systems. Ultimately, this will retire existing rules of thumb and antiquated policies that are currently used in the infrastructure and construction sector by replacing them with data-driven, technology-based and sustainability-aware strategies.



Peter Balogh

Assistant Professor of Mechanical and Industrial Engineering

Peter Balogh joins NJIT from Duke University, where he was a postdoctoral associate in the Department of Biomedical Engineering. His research involves computer simulations of blood flow, and will focus on modeling microscale biofluid dynamics associated with cancer progression. He will use high-performance computing to simulate cells flowing through 3D capillary networks in tumors, and model fluid transport mechanisms underlying their spread to lymph nodes. As a graduate student at Rutgers University, Balogh developed a new method to simulate cellular-scale flows of biological cells flowing through highly complex geometries, for which he was awarded the Andreas Acrivos Dissertation Award in Fluid Dynamics from the American Physical Society. He used this method to provide novel insights into blood cell dynamics during transport through complex vessel networks. At Duke, he was awarded the Big Data-Scientist Training Enhancement Program postdoctoral fellowship from the National Cancer Institute and VA Hospitals. Balogh's research on red blood cell transport through microvascular networks was featured on the cover of *Biophysical Journal*, showcased as a feature story for the Texas Advanced Computing Center, and has been featured in the press for the National Science Foundation. He has published in top journals, such as the *Journal of Fluid Mechanics* and the *Journal of Computational Physics*.

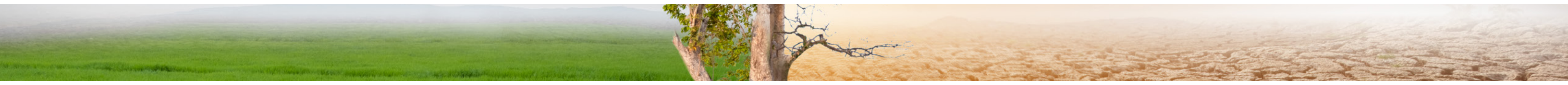
Research Abstract

In the human body, complex flow phenomena in the microcirculation play central roles in maintaining our health and facilitating growth. Blood flow through the microcirculation is responsible for transporting oxygen throughout our bodies and nutrients to our organs, while the lymphatic circulation maintains the body's fluid balance and circulates cells to fight infection. These systems can be hijacked by diseases like cancer which use the microcirculatory transport pathways to spread throughout our bodies. Complex flow simulations offer significant potential to provide new insights into such processes, although modeling which resolves the relevant features is highly nontrivial. In this talk, I will give an overview of a new method I developed for large-scale simulation of microscale biophysical flows using high-performance computing. I will discuss the research program I am developing at NJIT to use simulation to enable basic science discovery that improves our understanding of disease progression and informs new treatment approaches.

Alexander Buffone Jr.

Assistant Professor of Biomedical Engineering (Spring 2022)

Alexander Buffone Jr. comes to NJIT from the University of Pennsylvania, where he is a research associate in the Department of Bioengineering focused on training blood cells to migrate more effectively in order to better fight off infections. He has published several manuscripts demonstrating the ability of stem cells and white blood cells to migrate against the direction of blood flow. He and his co-workers were the first to demonstrate, for example, the capability of various blood cells to "swim upstream" like salmon when migrating through the vasculature during an immune response, and he was the first to reveal the critical signals controlling this phenomenon. While a Ph.D. student at SUNY Buffalo, Buffone was one of the first people to genetically engineer human white blood cells and demonstrate the critical "sugars" on their surface needed for them to properly fight off infections efficiently. Buffone has been the co-principal investigator on an NIH R21 grant from the National Institutes of General Medical Sciences with funding levels of more than a quarter million dollars per year over several years. His lab at NJIT will focus on genetically engineering immune cells to direct themselves through the vasculature to resolve inflammatory diseases.



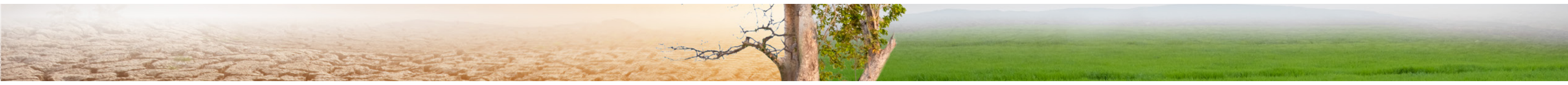
Kerri-lee Chintersingh

Assistant Professor of Chemical and Materials Engineering

Kerri-lee Chintersingh comes to NJIT after completing a postdoctoral fellowship in the Hopkins Extreme Materials Institute and the Department of Materials Science and Engineering at Johns Hopkins University. Her work there focused on the development, testing and characterization of novel materials and reaction models for defense applications, primarily systems that can be used against chemical and biological weapons of mass destruction. She was recently awarded beam time at the Department of Energy Argonne National Laboratory Advanced Photon Source, where she will explore methods to simultaneously characterize what happens internally and externally as a particle burns. At NJIT, she plans to expand her research to include the field of nanomaterials for chemical looping combustion to minimize the formation of atmospheric pollutants, such as nitrogen oxides and sulfur dioxides in industrial gas waste streams, by using metal oxides to react with hydrocarbon fuels. This technique could potentially lead to another hydrogen fuel source. She also intends to explore how metals burn at elevated temperatures and pressures and at high speeds, greater than the speed of sound, to reduce flight times and improve the effectiveness of aerospace propulsion applications. While pursuing a Ph.D. at NJIT, Chintersingh was invited as an early career scholar to speak at the Gordon Research Conference on Energetic Materials and at the Materials Research Symposium. She won the "Best Graduate Research" award from her department and has published in journals, such as *Combustion and Flame*, *Combustion Science and Technology* and the *Journal of Energetic Materials*.

Research Abstract

Powdered metal, metal oxide and metal composite systems can be tuned for environment, catalytic, energy and defense applications. One approach is to engineer the surface and microstructure of these materials for improved reactivity, morphology or reduced agglomeration by sputtering, ultrasonication, ball milling or coating techniques. The research involves the preparation, characterization and testing of novel nanostructured materials; improving the understanding of the role of microstructure, interface and particle surface on rheology, reactivity and consolidation; and the development of mechanisms describing material behavior under extreme conditions: high velocities, elevated pressures and temperatures. Customized lab-scale experiments and diagnostic tools are designed to simulate real-life dynamic environments giving the temporal and spatial information required to understand the femto to millisecond scale mechanisms. Computational fluid dynamics modeling is used to complement the experiments by describing the environmental conditions, and machine learning algorithms are used to extract features and anomalies from complex combustion scenarios.



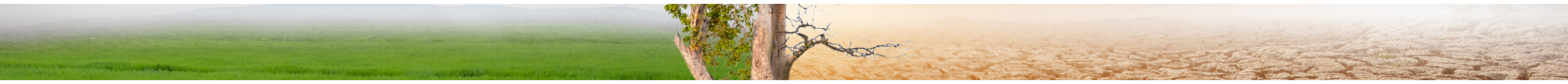
Tao Han

Associate Professor of Electrical and Computer Engineering

Tao Han joins NJIT from the University of North Carolina at Charlotte, where he was an assistant professor in the Department of Electrical and Computer Engineering. His research area includes mobile edge computing, machine learning, augmented/mixed reality systems and the internet of things. He works on the development of next-generation mobile networking and computing systems that enable advanced applications, such as augmented/mixed reality for health care, education, gaming, autonomous driving and tele-health. Han is the principal and co-principal investigator for several projects backed by the National Science Foundation (NSF) and the Department of Energy, with more than $6 million in total funding. He is designing a ubiquitous machine vision system that can efficiently extract, transfer and share useful information from ubiquitous cameras while preserving user privacy. He is developing a 3D airborne computing and networking system with a swarm of radio access points and edge servers carried or deployed by unmanned aerial vehicles, and researching communication protocols for integrating distributed renewable electricity generation and storage systems into the power grid. Han is the recipient this year of an NSF CAREER Award, as well as the Newark College of Engineering Outstanding Dissertation Award in 2016, the NJIT Hashimoto Prize in 2015 and the New Jersey Inventors Hall of Fame Graduate Student Award in 2014. His papers won the IEEE International Conference on Communications "Best Paper" award in 2019 and the IEEE Communications Society's Transmission, Access, and Optical Systems "Best Paper" award that same year.

Research Abstract

The next generation of wireless technology promises advanced network capabilities with extremely high bandwidth and ultralow latency that will catalyze a wide range of new mobile services and customer applications in vertical sectors such as transport, media and manufacturing. The explosion of networking connections and the diversification of network services will dramatically increase the complexity of network management. This talk will discuss the design of domain-specific deep reinforcement learning methods and systems to automate the configuration, provisioning and orchestration of network resources and services in next-generation wireless edge computing networks.



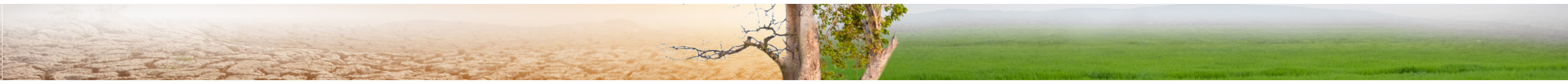
Amir Miri

Assistant Professor of Biomedical Engineering

Amir Miri currently serves as the director of the Advanced Biofabrication Laboratory at NJIT and his research group works on bioprinting platforms for creating disease models and microfluidic chips. His research interests have been focused on structure-mechanics relations in biological tissues and development of biofabrication methods. His doctoral research involved multiscale characterization of soft tissue biomechanics using analytical tools and a variety of mechanical testing methods. His postdoctoral training included advanced manufacturing of biomedical scaffolds and organoids using 3D bioprinting techniques. During his training at Harvard-MIT Health Sciences & Technology, he pioneered the design of multimaterial stereolithography and extrusion bioprinting platforms to fabricate microtissue models and organoids. He has authored more than 49 peer-reviewed articles and presented his work in more than 20 international conferences. He is now building up his research group on organ-on-chip platforms. The group includes two doctoral students, two MS students and several undergraduate trainees. They have customized three novel bioprinting systems within the last year.

Research Abstract

The cancer microenvironment is highly complex and highly dynamic, with distinctive key features presenting at each of the different stages of the disease. In particular, the large-scale growth of a tumor ultimately requires a blood supply, which leads to abnormal vascularization in the tumor spheroid when compared to healthy tissue. Despite significant advances in conventional cell cultures and animal models, they do not necessarily replicate tumor microenvironments that involve sprouting vasculature and tissue stiffness that affects the behavior and directionality of the cancer cells. I hypothesize that the use of the proposed platform will allow the fabrication of a clinically relevant tumor model to replicate the structural complexity of tissue vasculature. We will use bioprinting and cell-laden hydrogels to create bioprinted tumor-on-a-chip for drug testing. The focus will be on building bioprinted soft-tissue tumor modeling and multiculture systems.



Martin Tuchman School of Management

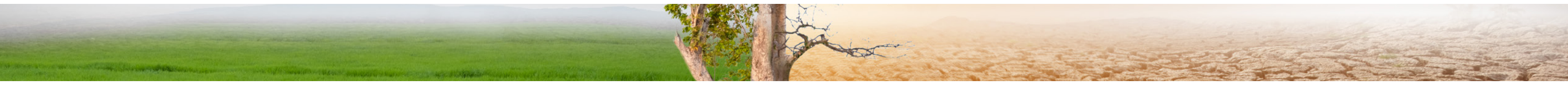
Joseph Micale

Assistant Professor of Accounting

Joseph Micale comes to NJIT from Fordham University, where he was the first Ph.D. graduate from the Gabelli School of Business. His areas of research are accounting, auditing, regulatory policy and capital markets, with a focus on audit partner quality and the influence of regulation changes on auditors' fees. Micale and his co-authors are investigating the impact of a recent congressional law that aims to reduce mandatory disclosure and compliance on auditing costs during firms' initial public offerings (IPOs), finding that the law had long-term benefits to firms in the form of reduced auditing fees over their first five years of capital market participation. Another research project utilizes auditors' perspectives on firms' uniqueness from their peers to interpret why investors trade stocks differently for some stocks versus their peers' stocks. This research provides insight into the economic meaning of a commonly used metric, Stock Return Synchronicity, which has been debated among academics in the literature. He received an "Outstanding Student Paper" award at the 2019 Global Ph.D. Colloquium and recently received an "Excellence in Reviewing" award from the Financial Accounting and Reporting Section of the American Accounting Association.

Research Abstract

This paper investigates the question of whether good audit partners are born or groomed. I identify several audit partners at top-tier public accounting firms who began their careers at lower quality institutions (hereafter: Start-nBign) and investigate whether these ex-ante lower-quality individuals can grow into high-quality auditors or if their arguably lower talent persists over time. Using hand-collected data on partners from LinkedIn, I find that Start-nBign partners provide higher quality audits and are associated with higher audit/abnormal audit fees, driven by a constraint on their clients' income-increasing accruals. Supporting this association, I find that clients switching to Start-nBign partners immediately reduce discretionary accruals. Overall, Start-nBign partners focus on fewer, better-quality audits, suggesting a competitive differentiation strategy, which is recognized by their audit firms who entrust their more complicated clients to these partners.



Ying Wu College of Computing

Kazem Cheshmi

Assistant Professor of Computer Science

Kazem Cheshmi comes to NJIT from the University of Toronto, where he earned a Ph.D. focused on building new programming languages for developing fast programs involving mathematical operations, which are used in scientific computing, computer graphics and machine learning. He has also been a researcher at Microsoft Research, Adobe Research and Rutgers University. Cheshmi developed Sympiler, a domain-specific compiler, or program, that automatically translates the source code from a programming language to a code the computer can understand. His program generates high-performance codes for complex matrix computations derived from massive datasets used in climate modeling, engineering design and simulation, as well as graph analytics. A matrix is a grid architecture that is used to store, track and manipulate data. As data sets have grown, matrix computations have in turn become increasingly complex. Sympiler, which was designed to address this problem, is extended to control robots and to design computer animations and is scalable to some of the most powerful high-performance computers (HPCs). Cheshmi's work has been recognized with awards, such as an ACM-IEEE CS George Michael Memorial HPC Fellowship, the grand final award of the 2017 ACM Student Research Competitions, a Wolfund fellowship in 2019 and an Adobe fellowship in 2018.

Yao Ma

Assistant Professor of Computer Science

Yao Ma joins NJIT from Michigan State University (MSU), where he completed a Ph.D. in computer science. His research interests include network embedding and graph neural networks (GNNs) for learning low-dimensional vector representations on graph-structured data. His work has broad applications in fields which are based on graph-structured data, such as online recommendations, social media, education and health care. His recent book, Deep Learning on Graphs, has attracted tens of thousands of downloads from more than 100 countries. His work has been presented in top-tier conferences, such as KDD, ICML and NeurIPS. He was the leading organizer and presenter of three tutorials on GNNs at top conferences including AAAI in 2020, KDD in 2020 and AAAI in 2021, attracting more than 1,000 attendees in total. Ma received the Outstanding Graduate Student Award from the College of Engineering at MSU for the 2019-2020 academic year.

Research Abstract

Graph-structured data are ubiquitous in the real world such as social networks and molecular graphs, and are emerging among a plethora of other, diverse domains. Therefore, it is of great research importance to design advanced algorithms for representation learning on graph-structured data to facilitate improved predictions across numerous computational methods. Graph Neural Networks (GNNs), which generalize the deep neural network models to graph-structured data, pave a new way to effectively learn representations at both the graph and individual node levels. We focus on the fundamental research of GNNs by developing novel algorithms and also practical research of GNNs by investigating their safety issues and real-world applications.

Shantanu Sharma

Assistant Professor of Computer Science

Shantanu Sharma comes to NJIT following a postdoctoral fellowship at the University of California, Irvine (UC-I). He works primarily at the intersection of database management systems and security and privacy. Sharma has developed several techniques for scaling cryptographic techniques for large-size data sets, which have been incorporated in a real-time, privacy-preserving, WiFi-based system called TIPPERS. The system uses WiFi infrastructure, WiFi connectivity data in particular, for localizing people both inside and outside buildings, and it is operational at UC-I and the U.S. Navy's Naval Information Warfare Center. Since WiFi connectivity data capture human behavior, Sharma develops ways to implement users' consent that, in turn, develops innovative attestation methods, as well as secure and privacy-preserving data analysis methods that do not reveal users' behavior to any other users on the TIPPERS system. One of his papers on secure and privacy-preserving sensor data attestation received the "Best Paper" award at the IEEE International Symposium on Network Computing and Applications. His work on secure database management systems has been published in tier-1 conferences, such as the ACM Special Interest Group on Management of Data, Very Large Data Bases and the IEEE International Conference on Data Engineering (ICDE), and in several IEEE and ACM *Transactions* journals. He was the leading organizer and presenter of tutorials on advances in secure data management at the IEEE ICDE in 2020 and at the IEEE International Conference on Big Data in 2019. One of his collaborators is Professor Jeffrey Ullman of Stanford University, the 2021 Turing Award winner.

Research Abstract

Widespread adoption of sensor data-driven approaches requires mechanisms/technologies to overcome the challenge of trust – both in the data itself and in the infrastructure that processes the data. A key building block for data-driven applications is the cloud, or edge infrastructure, to store, compute, analyze and share the data. While the privacy laws such as GDPR and CCPA focus on building trusted systems, the real implementation of such laws in a data-driven system is not a trivial task. My research work focuses on designing and implementing data-driven systems that are secure and privacy-preserving.

Hua Wei

Assistant Professor of Informatics

Hua Wei joins NJIT from Pennsylvania State University, where he received a Ph.D. from the College of Information Science and Technology. His research areas are reinforcement learning (RL), a machine learning training method that can be used for real-world operations, such as optimizing the timing of traffic signals, and data mining that deals with spatial and temporal data, with a focus on real-world applications, such as urban systems and health care. His work is aimed at facilitating growing autonomous vehicle traffic, adopting traffic signal controls based on traffic flow, and many types of smart city and cyber-physical systems, such as smart retail. Wei studied a broad range of challenges in RL for traffic signal control problems, including coordinating the actions of multiple traffic signals, to the scale of thousands of agents. He focuses on enabling the direct and safe application of RL agents in the real world, through building more realistic simulators from data, investigating the foundation of offline RL methods, including learning from offline, pre-logged data, and investigating attacks on RL agents. He has published papers at top conferences, such as Knowledge Discovery and Data Mining, the Association for the Advancement of Artificial Intelligence and the International Joint Conference on Artificial Intelligence. He won the “Best Paper” award at the European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases in 2020.

Research Abstract

This talk presents how to utilize mobility data and advanced learning methods for real-world decision-making, especially in urban environments. First, I will start with an example of reinforcement learning in the traffic signal control system and discuss the challenges to deploy it in the real world. Second, the talk presents our recent research results in tackling these challenges, which are published in recent AAAI, IJCAI, USENIX Security and ECML-PKDD conferences. Finally, I would like to discuss the open problems in this research topic and its implications for smart city applications.

Faculty Seed Grant Recipients

Mark Cartwright
Assistant Professor of Informatics

Current approaches for understanding long-term audio at scale are limited. For example, modern sound event recognition models have relatively small, fixed vocabularies that provide a limited view of the acoustic world. In this talk, we will introduce a project that aims to define the problem of open world sound event recognition from both technical and human perspectives, grounded in the context of analyzing longitudinal environmental audio data. We will discuss our initial progress in developing both datasets and multilabel open world sound event recognition models that can identify and describe unknown classes.

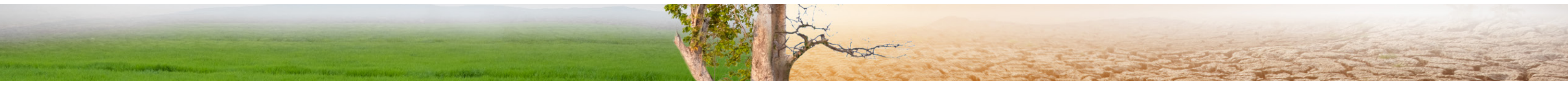
Lin Dong
Assistant Professor of Mechanical and Industrial Engineering

Self-sustaining energy generation and supply, rather than invasive battery replacement, represent a new frontier to greatly extend the lifetime and effectiveness of implantable biomedical devices, such as cardiac pacemakers. However, there is a lack of promising technologies that can efficiently covert the mechanical energy of the heart into electrical power without interfering with cardiovascular functions. Here we present integrated piezoelectric-based energy harvesting and sensing designs, which can be seamlessly incorporated into existing implantable medical devices for ease of clinical translation. This FSG project also addresses the key problem of practical heart failure (HF) symptom-monitoring by developing advanced sensing materials for dynamic monitoring of HF, and thus improves cardiovascular care and patient outcomes. The success of this research will open new avenues for self-sustaining energy generation and medical sensing strategies with potential transformative applications in cardiovascular diseases.

Jonathan Grasman
Assistant Professor of Biomedical Engineering

Saikat Pal
Assistant Professor of Biomedical Engineering

Volumetric muscle loss (VML) ensues from traumatic events such as car crashes, cancer resections and combat injuries, and significantly impacts patient quality of life and mobility. The standard of care for these procedures is an autologous tissue transfer, which is limited by modest functional recovery and minimal restoration of fine motor control. Therefore, there is a significant need to develop alternative approaches to the treatment and rehabilitation of these injuries. The overall goal of this project is to address a critical gap in knowledge in the literature, which is understanding how exercise may impact recovery from VML. We will match contractile force output recovery of animals with an assessment of gait mechanics, which is a relatively new method in VML research. We aim to form a temporal correlation between deficits in gait with VML injury, and ultimately will assess how exercise impacts both the force output and gait mechanics to develop new treatment paradigms for VML.



Murat Guvendiren
Assistant Professor of Chemical and Materials Engineering

Fibrotic diseases — including diseases of the heart, lungs, liver, kidneys and skin, resulting from a wide variety of etiologies — account for nearly half of the deaths in the U.S. Liver fibrosis and its end-stage variant, cirrhosis, are significant contributors to these statistics and of increasing concern, particularly since one form of liver disease, non-alcoholic fatty liver disease (NAFLD), is increasing rapidly. Cirrhosis is characterized by irreversible remodeling of the liver architecture and features thick collagenous septae enclosing nodules of hepatocytes. In NAFLD, small groups of lipid-laden hepatocytes are enclosed by matrix even in early disease. In both settings, the relationship between the abnormal extracellular matrix, specifically the encasement of hepatocytes, is difficult to model in vitro, especially in 2D systems. Our goal is to develop an in vitro system to define the impact of matrix encasement using 3D bioprinting to fabricate 3D liver models that mimic the physiology and anatomy of fibrosis and cirrhosis.

Alexei Khalizov
Assistant Professor of Chemistry and Environmental Science

Gennady Gor
Assistant Professor of Chemical and Materials Engineering

Health care facilities and other buildings rely on porous media filters to remove volatile organic compounds (VOCs) from indoor air. Filters are replaced on a calendar basis due to the lack of appropriate filter capacity diagnostics. We will develop an inexpensive in-operando method to estimate remaining filter life based on measuring the speed of ultrasound propagation through the filter medium, providing a more sustainable and less expensive solution compared to the calendar-based replacement. To test our premise that the speed is related to the amount of adsorbed VOCs and hence remaining filter capacity, we will measure the changes in ultrasound propagation during the adsorption process for different VOCs and media. Using a range of frequencies and transducers, we will identify inexpensive piezo-crystals for further commercialization, helping to develop a prototype ultrasonic sensor. The data will serve as preliminary results in the NSF (fundamentals) and DOE (shale probing) proposals.

Vivek Kumar
Assistant Professor of Biomedical Engineering

Ischemia of the microenvironment and neuronal death after traumatic brain injury are associated with poor healing responses and significant cognitive decline. We have designed a self-assembled peptide hydrogel that can be implanted in the injury site in the brain to assist the physiological healing response. The goal of this proposal is to determine the biodistribution and long-term degradation profile of the peptide in a murine model after implantation. After implantation of a fluorescently labeled peptide, we will determine the distribution of the peptide in the internal organs in the short term and long term. We expect to detect whether the peptide induces any off-site toxicity and determine the route through which the body degrades and disposes of the biomaterial.

Michael Lee
Associate Professor of Informatics

There is a continuing deficit of skilled workers who are trained in computing fields. Moreover, diversity in the computing-related workforce is severely lacking, contributing to severe inequities in software design and use, especially with disproportionately low participation by women and minority groups. Our goal is to investigate how to broaden participation in programming for dozens of older adults (55+) and hundreds of middle school students in the city of Newark, N.J., through intergenerational coding camps. The significance of this research is to contribute new insights into how to implement intergenerational programming with coding activities for underrepresented and underserved individuals in computing. We aim to: create and deploy an intergenerational coding camp for middle school youth and older adults; better understand the unique needs of learners with different motivations and levels of life and coding experience; and investigate the effects that occur from participating in such a coding program.

James MacLaurin
Assistant Professor of Mathematics

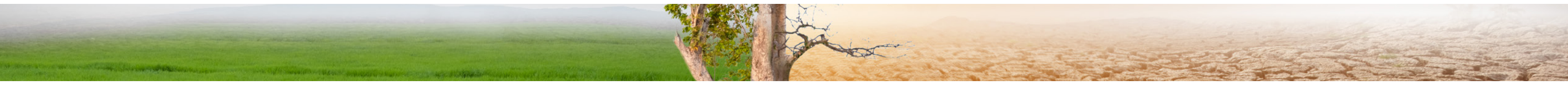
Numerical simulations of “spin-glass” systems are performed. These are paradigmatic models of high-dimensional complex systems with a very disordered energy landscape. They typically exhibit slow glassy behavior in the low temperature limit. Mean-field systems (with all-to-all interactions) and nearest-neighbor systems are studied.

Neil Maher
Professor of History

My presentation will cover the development of a mapping website and digital archive that I’ve created for the public dissemination of undergraduate and graduate research on environmental justice history. The website (ejhistory.com) currently archives the research of more than 100 NJIT and Rutgers University-Newark students. Over the course of a semester, each of these students chose a single site/location where environmental inequity has occurred, conducted historical research regarding both the environmental problems at the site, as well as the activism of local residents, and then posted their work to this publicly accessible website. The presentation will discuss how I created the original website for this student research, and then how an NJIT Faculty Seed Grant allowed me to develop the original site into a more robust, useful and publicly inclusive mapping and digital archive of environmental justice history in the Newark region and beyond.

Calista McRae
Assistant Professor of Humanities and Social Sciences

I concentrate on two projects that will bring awareness to a slow-motion ethical and ecological disaster: our increasingly estranged relationship to animals. My current book project, Other Species and Our Feelings: Animal Ethics in Contemporary Lyric, examines an array of contemporary American poets (1970–2020) who are struck by the increasing power that humans wield over nonhuman life. The second and public-facing component of this project brings questions of human intervention and emotivity into dialogue with conservation, outreach and advocacy. How do we convey largely imperceptible threats to wildlife? I discuss an interdisciplinary website that stems from the problem of window collisions in Newark. Both the book and this website are driven by my interest in reckoning with the roles that emotions play in human-nonhuman interactions across the humanities, whether compelling us to action or obscuring our thought.



Farzan Nadim
Professor of Biology

Horacio Rotstein
Professor of Biology

Dopamine release from the substantia nigra (SNc) midbrain neurons is essential for the initiation of all voluntary movements and their disorder leads to debilitating motor dysfunction such as Parkinson's disease. Dopamine is also essential for motivation and reward, such that all addictive drugs converge on activating the midbrain dopamine pathways. We describe a new neural pathway from the cerebellum to the SNc and show that this pathway provides information on both motor movement and reward value. We hypothesize that cerebellar modulation of SNc plays a central role in the reward-based learning process. We use computational modeling to explore two important questions on the role of the cerebellar-to-SNc pathway: how the motor and reward cerebellar signals contribute to dopamine actions in producing specific motivated movements in trained animals; and how this pathway contributes to the progression of learning in classical and operant conditioning tasks.

Taro Narahara
Associate Professor of Architecture

This project creates and analyzes large-scale datasets of real estate floor plans in New York, Los Angeles and London. As a preliminary work, I have constructed a dataset based on Japanese apartments and developed an accurate prediction model for subjective scores of apartments using a proposed multimodal Deep Neural Network model in collaboration with data scientists at the University of Tokyo. The datasets include apartments with various sizes, metadata, semantically segmented floor plans, adjacency graphs representing layouts, and subjective evaluations of floor plans based on living comfort, using crowdsourcing. To the best of my knowledge, there is no such dataset with subjective evaluations based on floor plans from major cities. The datasets will have potential applications in the real estate and architecture industries, such as layout synthesis and apartment-searching tools. My goal is to scientifically understand the professional decisions made by architects that influence the quality of spatial designs.

Hieu Nguyen
Associate Professor of Electrical and Computer Engineering

High-performance single photon source (SPS) plays a key role in future quantum technologies. Their key applications include quantum photonics, quantum communication, quantum computing and quantum sensing. An ideal SPS must be robust, coherent, tunable and have high brightness. Moreover, each emitted photon should be collected with high collection efficiency and be identical with similar polarization. However, the achievement of such a quantum light source has not been successfully demonstrated due to several challenges. In this project, we aim to develop high brightness and a single-photon purity light source with the molecular beam epitaxy (MBE) grown InGaN quantum dot in (Al)GaN nanowire that meet the aforementioned specifications. The position of quantum dots could be properly controlled using an MBE growth approach. The dimension and structure of the nanowire can be engineered, providing effective photonic cavity and waveguides for the enhanced light extraction efficiency which is important for high brightness light-emitters.

Bryan Pfister
Professor of Biomedical Engineering

Outcomes from mild traumatic brain injuries (TBI)/concussions in humans vary greatly and do not always present with strong symptoms. Patients, however, can sustain persistent cognitive deficits and are considered a risk factor for chronic neurodegenerative pathology such as chronic traumatic encephalopathy and Alzheimer's disease. Repetitive TBI cases are a particularly important classification of mild injury where outcomes are exacerbated over repeated occurrence. The successful completion of the aims of this proposal will elucidate the activation of regulated cell death pathways as targets for the prevention of progressive cell loss and dysfunction associated with mild and repeated mild TBI. Accordingly, this proposal will focus on identifying the regulated cell death pathways initiated by a mild injury that may also be responsible for predisposing the brain to exacerbated outcomes from a second, repeat injury.

Lucia Rodriguez-Freire
Assistant Professor of Civil and Environmental Engineering

In this project, we investigate the role of plant endophytes and rhizosphere microorganisms as main drivers for perfluoroalkyl substances (PFAS) bioavailability and the PFAS effect in the rhizosphere and in planta (endosphere) microbial community. Our main hypothesis is that the microbe-plant interactions dictate the rate of uptake and distribution of PFAS by plants under varying environmental conditions, and the plants' toxic response to PFAS promotes changes in the specific microbial community in the plant that will decrease PFAS bioavailability. The main research objectives for this work are: evaluation of the rhizosphere and in planta PFAS metabolic transformations in hydroponics and greenhouse experiments; and assessment of plant and microbial communities' response to PFAS exposure through metabolomics and metaproteomic studies. This work will provide a holistic understanding of the role of plant microbiome on contaminant fate, and it will inform future remediation strategies and exposure prevention alternatives.

Raja Roy
Assistant Professor of Innovation and Entrepreneurship

Shanthi Gopalakrishnan
Professor of Management

Xi Zhang
Ph.D. Candidate, Martin Tuchman School of Management

We explore the antecedents that lead to the Unicorn Space Ventures (USVs) and uncover USV's characteristics that differentiate such ventures from others. A study such as ours is critical, because the field of business and entrepreneurship has experienced a flurry of unicorn ventures in recent times. Companies such as Zoom have been valued in the tens of billions of dollars prior to their IPO. Moreover, the world economy is undergoing a revolutionary change with NASA's upcoming Artemis missions for sustainable human habitation of the Moon in the 2020s and Mars in the 2030s. The number of startup space companies that reported investments in 2019 was 135, up from 101 in 2018 and the number of investors in space ventures has also increased exponentially. Our objective is to shed new insights at the intersection of these two emerging trends that will benefit aspiring technology entrepreneurs interested in space exploration.

Gareth Russell
Associate Professor of Biology

Daniel Bunker
Associate Professor of Biology

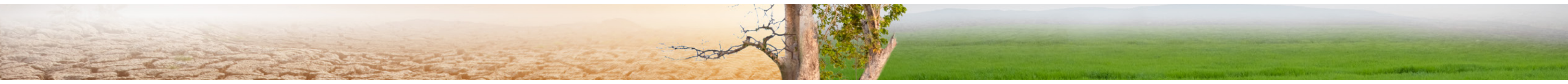
Maria Stanko
Senior University Lecturer of Biology

Caroline DeVan
University Lecturer of Biology

The Urban Ecology Lab (UEL) at NJIT is a cooperative, multi-PI undergraduate research lab and academic community. The mission of the UEL is to train the next generation of leaders in conservation biology, sustainability and environmental justice, and to ensure that such leadership reflects the communities they will serve. UEL research will focus on our campus and local community and may cover any combination of ecology, conservation sustainability and environmental justice. Our first UEL event, the September 2021 campus bioblitz, broke all previous records for student participation and data collected. Looking forward, the UEL also aims to recruit students to NJIT from Newark and surrounding areas to pursue careers related to the environment, urban environments in particular.

Mesut Sahin
Professor of Biomedical Engineering

Most spinal cord injuries (SCI) are incomplete injuries, and current rehabilitation protocols for restoring the lost motor functions are geared toward promoting new synaptic connections with the remaining intact axons in the descending tracts. The most effective treatments combine the passive movements of the limbs, such as by a physical therapist, while the subject is making efforts to move the limbs actively. Electrical stimulation of the spinal cord can improve the outcomes of rehabilitation by elevating the excitability of the neural circuits in the spinal cord gray matter. However, electrical stimulation with epidural placement of the electrodes has a poor spatial selectivity due to difficulties in producing a focal activation and steering of the electric fields. Low-amplitude focused ultrasonic stimulation (FUS) overcomes these problems and thus has a better potential to improve the outcomes of rehabilitation after SCI. In this project, the overarching goal is to determine the modulatory effects of FUS on the gray matter of the spinal cord.



Xiaonan Tai
Assistant Professor of Biology

Huiran Jin
Assistant Professor of Engineering Technology

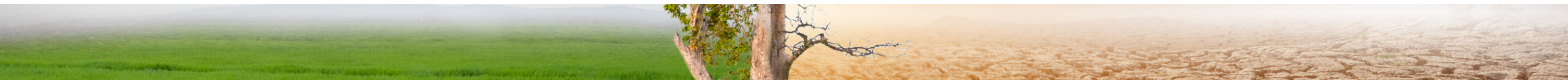
Climate change poses fundamental threats to the sustainability of ecosystems worldwide. Forested river and stream ecosystems provide critical functions related to carbon and water, biological habitats and recreational activities. However, our current knowledge about the two-way, cross-scale interactions between riparian ecosystem dynamics and environmental change is largely system-dependent and rarely considered in land surface and Earth models. Our objective is to link riparian vegetation dynamics to hydroclimate variations and assess the functional importance of riparian ecosystems to macrosystem fluxes of carbon and water. We will leverage high-resolution data from the National Science Foundation's NEON's airborne observation platform, long-term satellite imagery and process-based modeling to characterize the dynamics of riparian vegetation cover during the past several decades; explore mechanistic explanations underlying changes of riparian vegetation and quantify the relative importance of various hydroclimate factors; and assess the role of riparian vegetation in contributing to and stabilizing macrosystem fluxes at regional and global model scales.

Dimitri Theodoratos
Associate Professor of Computer Science

Labeled graphs and heterogeneous information networks can model complex relationships and are used to represent data in a multitude of modern applications. The goal of this project is to present a new framework for addressing the problem of efficiently finding homomorphic matches for hybrid patterns, a fundamental operation for the analysis and exploration of large data graphs. A core idea of the approach is the use of the novel concept of summary graph to compactly represent the query results and to exploit computation sharing. The project involves the design of worst-case optimal multiway join algorithms for the construction of summary graphs. This approach also involves techniques for pruning the data graph to reduce the search space using forward and backward simulation techniques. The results of this project will greatly benefit a wide range of graph-based applications which are used in practice, including graph database and knowledge base engines.

Xiaoyang Xu
Associate Professor of Chemical and Materials Engineering

As the United States recovers from the COVID-19 pandemic and economic shutdown, there is a need for a vaccine development strategy that can accommodate rapidly changing viruses and be quickly scaled up to deal with both seasonal and pandemic situations. The goal of our research is to develop thermostable nucleic acid (i.e., DNA and mRNA) vaccines with long shelf lives using our newly developed and uniquely structured polymeric nano-delivery platform as nucleic acid delivery carriers. They can successfully transfect cells with sustained release behavior, owing to degradation properties of the exceptional structure of a polymeric shell encapsulating cationic polymer/nucleic acid complexes. We aim to protect nucleic acids from endonuclease degradation, while delivering a combination of antigen-encoding DNAs/mRNAs for increased efficacy, ultimately generating a robust vaccine platform capable of combating the rapidly changing viral landscape.



Junjie Yang
Assistant Professor of Physics

Ionic solids that possess exceptionally high values of electrical conductivity are called superionic conductors. They have potential applications in electrochemical cells, fuel cells and solid-state batteries. The crystal structure has been proposed to play a major role in determining whether a material may have a high ionic conductivity. However, the detailed relationship between the crystal structure and ionic conductivity has not been well understood. Recently, the PI and her collaborators obtained high-quality bulk single crystals of Y-stabilized hafnia $Hf_{1-x}Y_xO_{2-\delta}$, which exhibit a series of complex structural phase transitions with increasing Y concentration. The intrinsic oxygen vacancies in $Hf_{1-x}Y_xO_{2-\delta}$ indicate that it is a good candidate of superionic conductors. $Hf_{1-x}Y_xO_{2-\delta}$ bulk crystals provide an excellent platform to reveal the correlation between crystal structure and ionic conductivity. The goal of this project is to uncover the correlation between crystal structure and ionic conductivity in doped HfO_2 single crystals.

Joshua Young
Assistant Professor of Chemical and Materials Engineering

Sagnik Basuray
Associate Professor of Chemical and Materials Engineering

Perfluoroalkyl substances (PFAS), used extensively for their water-resistant properties, have been identified as emerging contaminants of major concern, but are difficult to detect and capture. There is a need for technology capable of removing PFAS to ensure access to clean water. Recently, metal-organic framework materials (MOFs) have been proposed. However, the number of MOFs is enormous, making optimization challenging. Here, we use high-throughput calculations and machine learning to study PFAS interactions with MOFs and identify new ones for improved sensing technology. We compute the adsorption strength of PFAS molecules in several hundred MOFs, creating a large dataset. This is then used to train machine learning models, which link the most important characteristics of MOFs to PFAS adsorption. These models are then applied to a database of 160,000 MOFs to identify compounds with improved PFAS detection and removal capabilities. Finally, optimal materials are synthesized and integrated into electrochemical sensing devices.

Andrzej Zarzycki
Associate Professor of Architecture

This research develops a digital-twin prototype connecting a virtual model with physical building components. This digital twin implementation will enable building asset cataloging and tracking while synchronously updating the digital 3D model. It utilizes radio frequency identification (RFID) tracking technology and wireless communication to inform building information models (BIM). The trackable assets include furniture, appliances and fixed building assembly components, as well as occupants. In addition to tracking (localizing) assets within BIM models, database information on individual components could be updated with individual product specifications, warranties and other characteristics to represent a current state of the building. The research outcomes will include a sensor-based building information prototype and Autodesk Revit (software) plugin interconnected into a unified platform. This approach will allow for an extended use of the BIM platform in the building's post-occupancy phases and potentially allow for an auto-update of virtual building assets.

Wen Zhang

Associate Professor of Civil and Environmental Engineering

Vivek Kumar

Assistant Professor of Biomedical Engineering

Taha Marhaba

Professor of Civil and Environmental Engineering

Compared to bulk bubbles, nanobubbles (NBs) in liquid exhibit unique characteristics, such as high colloidal stability, high surface charge density, diffusivity and tunable reactivity (e.g., radical formation). This project evaluated biofilm prevention when the liquid media (e.g., water) contains air or other gaseous NBs. The project tested two major running hypotheses that (1) hydrophobic NBs are thermodynamically inclined to adsorb on solid surfaces such as stainless steel; (2) the surface adsorption of NBs leads to a negatively charged bubble layer that will inhibit biofilm formation via electrostatic and steric repulsion against bacteria. We undertook different approaches such as interaction energy analysis using DLVO theories (colloidal dispersion stability) and electrochemical detection to evaluate bacterial deposition when NBs are present on pipe surfaces. The results indicate that bacterial deposition induces the electrode surface impedance changes due to the charge transfer resistance increase. Attachment of surface NBs could repel bacteria and thus prevent their deposition and the formation of biofilm.

Meng-Qiang Zhao

Assistant Professor of Chemical and Materials Engineering

Over the past months, we have developed an efficient method to achieve the growth of monolayer MoS2 and MoSe2 monolayer films by NaCl-assisted, spin-coating-based chemical vapor deposition (CVD). We noticed that the concentration of Mo precursor solution, growth temperature, gas flow rates, growth time and the content of growth promoter play important roles in the successful monolayer film growth. Both 2D MoS2 and MoSe2 high-density flakes and continuous films with a thickness around 1 nm were obtained. In comparison, the growth of continuous films required more precise control over the growth conditions. On the other hand, we also succeeded in the growth of large-area monolayer hBN films on Cu foils by CVD of ammonia borane.

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