NJIT PRESIDENT'S FORUM AND FACULTY RESEARCH SHOWCASE

Monday, February 22, 2016

NJIT
New Jersey Institute of Technology

The Inaugural President's Forum

At NJIT, we look forward to big and bold ideas. We educate our students to be innovative and relevant. And they graduate to become highly successful alumni who spend their careers at the forefront of technological advances. So when Board of Trustees Co-Vice Chair Vincent DeCaprio '72 first approached me about supporting a president's forum, I embraced the idea but knew that we needed just the right circumstances to bring our community together for an outstanding opportunity to engage, listen and discuss.

Now, as we welcome visionary Julian M. Goldman, MD to our campus, I am so grateful to Vince for this initiative. I'm pleased that this forum is part of the Albert Dorman Honors College Colloquium Series, open to all students who will share their insights and keep the conversation going for more than just the day.

And I can't think of a more appropriate launch than to pair this forum with our annual faculty research symposium, where we meet new rising faculty stars who are working to achieve interdisciplinary breakthroughs. This forum will teach, inspire and bring to life new relationships that will have lasting effects on our campus and beyond.

This day allows us to celebrate the breadth of work in NJIT's core strengths—life sciences and health care, data science and information technology, and sustainable systems—as well as to explore new initiatives and emerging technologies in broad areas of architecture, biology, cybersecurity, chemistry, design, engineering, environment, finance, humanities, mathematics, and the social sciences.

The new faculty participating today, who represent 18 of the 68 new hires over the past several years, are delving into critical areas that influence our current lives and will shape society for some time to come. With their expertise comes an exceptional amount of new NJIT resources in areas such as robotics – where we now have more in-depth study of human machine interaction, where we're creating intelligent computing based on the brain and where we're improving the manufacturing industry—big data, science policy, crowd funding, materials research, water remediation, solar flares and more.

Once again, I thank Vince and the DeCaprio family for their generous support in creating the President's Forum. It is an excellent addition to the full array of research and applied studies available to all NJIT students and our community.

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 nationally ranked public research university. This has been a remarkable transformation. In 1979, our research expenditures totaled $375,000; today they surpass $110 million. As our research profile grew, so did our capacity as an educational institution. Thirty-five years ago, NJIT granted no doctoral degrees; we have recently awarded more than 60 in 16 different disciplines during a single year. In short, the university has grown from its roots as a local college focused on teaching into a residential and highly selective research institution.

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, providing the environment necessary for success from the moment of their appointment to the peak of our scholars' academic careers. We also aim to break down barriers to multidisciplinary collaborations as contemporary research demands it. We value entrepreneurial research, promote our inventions and facilitate technology transfer.

Now, NJIT is embarking on a far-reaching plan to transform our research enterprise again, elevating the university to a top tier institution conducting groundbreaking research in many fields. We aim for prominence. Nowhere are these changes more apparent than in our people. Over the past four years, NJIT has brought nearly 70 new faculty members to campus as we deepen our capabilities across STEM and other disciplines. As part of the university's strategic plan, 2020 Vision, we are beginning a multiyear hiring effort that will grow our faculty even further, from 280 in 2014 to 345 by 2020. 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.

So it is with enormous pride that NJIT showcases its growing research talent in the Fourth Faculty Research Symposium. Some of the presentations you will hear today represent interdisciplinary collaborations brought to life on campus with seed funding from a new research program designed to tackle problems in fields such as the life sciences and health care, sustainable systems, and data science that represent the university's core strengths. They bridge disciplines as distinct as architecture and computer science. As we create new academic hubs on campus, we hope to inspire many more productive partnerships. Within the next five years, we will double funding from external sources.

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 P. Deek
Provost and Senior Executive Vice President

Program

Atrium

10-10:15 a.m.

Welcome
Joel S. Bloom
President

Vincent L. DeCaprio '72
Co-Vice Chair
NJIT Board of Trustees

Fadi P. Deek '85, '86, '97
Provost and Senior Executive Vice President
NJIT

10:15-10:20 a.m.

Speaker Introduction
Atam P. Dhawan
Vice Provost for Research

10:20-11:30 a.m.

President's Forum: Keynote Lecture
Julian Goldman, MD
Medical Director of Biomedical Engineering
Partners HealthCare

Ballroom B

11:30 a.m.-12:30 p.m.

Lunch and Networking

Ballroom A

12:30-2 p.m.

New Faculty Presentations

2-3 p.m.

Poster Presentations and Networking Session
New Faculty and Faculty Seed Grant Recipients

This 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.

Keynote Speaker

Julian Goldman, MD

Medical Director of Biomedical Engineering
Partners HealthCare

Dr. Julian M. Goldman is the medical director of biomedical engineering for Partners HealthCare, an anesthesiologist at the Massachusetts General Hospital, and director/PI of the Program on Medical Device Interoperability (MD PnP), a multi-institutional research program founded in 2004 to advance medical device interoperability to improve patient safety and HIT innovation.

Dr. Goldman performed his clinical anesthesia and research training at the University of Colorado, and is Board Certified in Anesthesiology and Clinical Informatics. He served as a Visiting Scholar in the FDA Medical Device Fellowship Program as well as an executive of a medical device company. At MGH, Dr. Goldman served as a principal anesthesiologist in the "OR of the Future" – a multispecialty OR that studies diverse technologies and clinical practices to enable broad adoption.

Dr. Goldman chairs the international standardization committee for the safety and performance of anesthesia and respiratory equipment (ISO TC 121), and serves in leadership positions of AAMI, UL and IEC standardization committees. He co-chaired the HHS HIT Policy Committee FDASIA Regulations Subcommittee and the FCC mHealth Task Force, and co-chairs the health care task group of the Industrial Internet Consortium. He was recently appointed as a Distinguished Lecturer for the IEEE EMBS.

Dr. Goldman's awards include the AAMI Technology in Health Care Clinical Application Award, the International Council on Systems Engineering Pioneer Award, the American College of Clinical Engineering Award for Professional Achievement in Technology, and American Society of Anesthesiologists awards for advanced technology applications to improve patient safety.

Faculty Research Presentations

Matthew P. Adams

Assistant Professor of Civil and Environmental Engineering

Matthew P. Adams joins NJIT from Oregon State University, where he recently completed his Ph.D. in civil engineering, specializing in the development and testing of innovative cement-based construction materials. Dr. Adams focuses on the link between the chemistry of concrete materials and their long-term durability and resiliency. He is an expert on the use of recycled concrete as a replacement for natural gravel in new concrete, an eco-friendly alternative that conserves natural resources and can reduce greenhouse gas emissions associated with construction. While completing his Ph.D., he developed a new test for determining the long-term strength of concrete made with calcium aluminate cement. That work led to a better understanding of the role sand and gravel play in the chemical reaction that occurs when cement and water are mixed together and the impact that has on long-term concrete strength and durability. Dr. Adams was recently awarded the 2015 Young Member Award for Professional Achievement from the American Concrete Institute.

Title: Advanced Cement-based Materials Research at NJIT

Infrastructure quality around the world is deteriorating at an alarming rate. Coupled with increased stress on our infrastructure from population booms, larger vehicles and more severe weather events it is imperative that we understand how our infrastructure materials will behave under these conditions. This presentation is a brief introduction to Dr. Adams' research into cement-based infrastructure materials. The work presented will show how we can link advanced fundamental understanding of the chemistry of cement-based materials to long-term performance in severe conditions. Additionally, Dr. Adams will discuss how we can use these same research tools to understand how innovative and sustainable materials will perform in everyday infrastructure applications.

Matthew J. Bandelt

Assistant Professor of Civil and Environmental Engineering

Matthew Bandelt comes to NJIT from Stanford University, where he recently earned his Ph.D. in civil and environmental engineering, specializing in structural engineering and emerging construction materials used in bridges, buildings and infrastructure. Dr. Bandelt focuses on cement-based composites which incorporate small polymeric and steel fibers to improve the structural performance and durability of reinforced concrete structures. He has developed specifications to design structures using these composites, as well as computational modeling tools to predict their behavior under earthquake loading. He is currently exploring the use of these composites and other novel cement-based materials to improve infrastructure durability against harsh environmental conditions, and to decrease construction times and project delays. Dr. Bandelt is a recipient of a five-year National Science Foundation Graduation Research Fellowship, and has published research in journals such as *Materials and Structures*.

Title: Resilient and Sustainable Infrastructure Through Advanced Materials and Building Systems

Aging infrastructure systems and rising levels of urbanization have motivated engineers, contractors and owners to develop new design methods to improve the life-cycle costs, sustainability and resiliency of the built environment. Dr. Bandelt's research focuses on the development, application and design of structural systems using novel materials and construction methods. He conducts physical experiments along with computational simulations to evaluate and predict the performance of novel materials and building systems. Recent research has focused on developing design standards and performance-predicting tools for structural components made with fiber-reinforced cement-based composites with applications to earthquake engineering.

Bin Chen

Assistant Professor of Physics

Dr. Bin Chen joined the faculty of NJIT in January 2016 from the Harvard-Smithsonian Center for Astrophysics (CfA), where he held a research scientist position. Prior to that he was a postdoctoral researcher at NJIT as a NASA Living-With-a-Star Jack Eddy Fellow. Dr. Bin Chen's research to date has focused on the physics of solar flares and coronal mass ejections, which are powerful explosions on the Sun that could affect our society and everyday life. His work involves utilizing observations from both ground- and space-based telescopes. In particular, he has been pioneering the use of a new generation of radio telescopes for solar studies. His recent work on the acceleration of charged particles by solar flares was published in the prodigious journal Science and featured in multiple press releases and news articles.

Title: Unraveling the Mysteries of Solar Flares

Solar flares are the most powerful explosions in the solar system. They release an enormous amount of energy in a short time scale, and have the potential of imposing severe damages to the vitality of our modern society. However, detailed physical processes involved in the catastrophic energy release of solar flares are still not well understood. Dr. Chen and his colleagues utilize observations from state-of-the-art telescopes at multiple wavelengths, combined with theoretical and modeling investigations, to unravel the mysteries behind these powerful explosions. His talk will emphasize the role of a new generation of radio telescopes in such studies.

Ming Fang

Assistant Professor of Accounting

Ming Fang joins NJIT from Fordham University, where she was a visiting assistant professor of finance in the Gabelli School of Business. Her research spans a range of topics within empirical accounting studies, including financial reporting, tax evasion, fraud and regulation, corporate innovation, and corporate governance. She views companies in a dynamic and interactive environment rather than as isolated entities, and emphasizes the human element in accounting practices. The goal of her work is to understand the effectiveness of accounting practices in conveying information to shareholders, regulators and debt holders. Her current research focuses on the impact that social connections among managers from different firms have on accounting practices such as earnings management and tax avoidance. She looks closely at connections such as past work experience, education, club memberships, charitable work and other social activities. While a graduate student at Rensselaer Polytechnic Institute she received a doctoral consortium fellowship from the American Accounting Association, among other awards.

Title: Executive Social Networks and Corporate Innovation

Social networks of business leaders are developed from their previous experiences in the forms of relationships with colleagues, schoolmates, friends, acquaintances and other connections. These social connections between business leaders serve as channels by which information is communicated, resources are exchanged, new relationships are formed, and existing relationships are leveraged. Drawing on the literature in graph theory, sociology, economics and business, this *interdisciplinary* project describes the social networks of business leaders based on the biographical information of their professional experience, education and recreational activities, and investigates how social networks of business leaders influence corporate innovation.

Brittany D. Froese

Assistant Professor of Mathematics

Brittany Froese joins NJIT from the Institute for Computational Engineering and Sciences at the University of Texas at Austin, where she held a three-year postdoctoral fellowship in mathematics sponsored by the National Science and Engineering Research Council of Canada. Dr. Froese specializes in the development of computational methods for solving challenging mathematical problems that arise in science and industry. She introduced, for example, a new mathematical framework enabling computers to solve the problem of "optimal transport," which involves determining the most cost-efficient way to transport material from one region to another. Her method is being applied in a variety of areas, from the detection of oil reservoirs to the design of lenses and reflectors to direct laser beams. She is currently working on more general classes of nonlinear equations, with applications to current problems in seismology, medical image registration and astrophysics. Her research has been published in journals such as the *SIAM Journal on Numerical Analysis* and *Communications in Mathematical Sciences*, and has led to the formation of an international research collaboration that connects optimal transport experts across Europe and North America.

Title: Numerical Methods for Optimal Transportation

Optimal transportation involves determining the most cost-effective rearrangement between two distributions of mass. The solution of this problem has implications for a number of applications, including mapping the earth's subsurface, designing lenses to control laser beams, weather prediction and medical-image processing. However, currently available numerical methods often fail for this highly nonlinear problem. Dr. Froese introduces new mathematical and computational techniques for solving a fully nonlinear partial differential equation, the Monge-Ampere equation, which is used to produce the solution to the optimal transportation problem.

Britt Holbrook

Assistant Professor of Humanities

Britt Holbrook comes to NJIT from Georgia Tech, where he was visiting assistant professor in the School of Public Policy focusing on the ethical and practical implications of science policy, with a particular emphasis on the connection between scientific and technical research and societal needs. Dr. Holbrook explores, for example, questions around public funding, such as whether scientists and engineers who receive federal or state research grants are obliged to address societal needs or are free to pursue knowledge for its own sake. From the policy end, he looks at whether funding agencies should institute a "societal impact" requirement and, if so, how they would implement it. Dr. Holbrook works closely with policymakers. In 2012, he was appointed to a three-year term on the American Association for the Advancement of Science Committee on Scientific Freedom and Responsibility. He has edited major reference works such as *Ethics, Science, Technology, and Engineering: A Global Resource*, the second edition of the *Encyclopedia of Science, Technology, and Ethics* from Macmillan Reference USA. He is currently writing a book on accountability demands faced by public universities.

Title: Assessing the Broader Impacts of Science, Technology and Research

Intrinsic value, the sort of value that something has in itself and for its own sake, has long been considered more valuable than instrumental value, the sort of value that something has for the sake of something else. Research has often been justified on the grounds that it has intrinsic, rather than instrumental, value. Increasingly, however, researchers are being asked to demonstrate that their work has broader societal impacts, in addition to its intrinsic merit. Dr. Holbrook's research investigates this shift and how researchers might best respond to it.

Yong-Ick Kim

Assistant Professor of Chemistry and Environmental Science

Yong-Ick Kim joins NJIT from the University of California, San Diego, where he was a postdoctoral researcher at the Center for Circadian Biology. Dr. Kim studies the biochemical mechanisms underlying circadian rhythms, the bodily and behavioral changes tied to the 24-hour daily cycle that are responsive to light and darkness. His research to date has focused on pinpointing the activation and inhibition of proteins integral to regulating the circadian clock and on the biochemical mechanisms that reset it. Dr. Kim is interested in examining disruptions such as jet lag in order to help devise effective treatments. His research on the molecular mechanisms of the circadian clock has been published in journals such as the *Proceedings of the National Academies of Science*, *Cell* and *Science*.

Title: The Molecular Mechanism of the Cyanobacterial Circadian Clock

The central oscillator of cyanobacterial circadian clock is encoded by three genes, KaiA, KaiB, and KaiC, whose protein products function together to generate a 24-hour rhythm of KaiC phosphorylation. KaiC has two residues (Ser431, Thr432) that can be phosphorylated, and modulation of KaiC's autokinase and autophosphatase activities generates a 24-hour period phosphorylation and dephosphorylation rhythm. KaiA activates the autophosphorylation of KaiC and KaiB attenuates KaiA's function, resulting in KaiC dephosphorylation. The 24-hour KaiC phosphorylation rhythm is generated by timely association and dissociation among these three Kai proteins. The 24-hour rhythm of KaiC phosphorylation can be reconstituted in vitro by mixing purified KaiA, KaiB and KaiC with adenosine triphosphate (ATP).

Michael J. Lee

Assistant Professor of Information Systems

Michael Lee joins NJIT from the University of Washington, where he recently completed his Ph.D. in Information Science, specializing in the areas of Computing Education Research and Human-Computer Interaction. Dr. Lee focuses on ways to engage and instruct people in programming and to measure their progress. He created Gidget (helpgidget.org), a multilevel game designed to teach people of all ages how to program by solving debugging puzzles. He also developed a tool for children in which a programmable robotic dinosaur acts out their stories. Two of his publications related to these projects have received "Best Paper" awards at peer-reviewed venues sponsored by the Association for Computing Machinery. Dr. Lee was also the recipient of a National Science Foundation grant to work with international collaborators to examine the effectiveness of Gidget in different cultures, and to explore how software developers select projects to work on from a large, open online software repository.

Title: Teaching and Engaging With Debugging Puzzles

Programming is increasingly becoming an important 21st century skill. In the United States alone, computer science-related jobs are increasing at double the national average and are among the top paying positions, but there are not enough people trained to fill these roles. Major efforts have attracted millions of people to try programming using many of the discretionary learning resources available for free online. Unfortunately, it is unclear who these online educational resources attract, and how they affect engagement and learning. Dr. Lee creates technologies to address these issues. His freely available game, Gidget (helpgidget.org), has reached thousands of people all over the world. It has shown to be engaging, demonstrated measurable learning outcomes, and has been successful at reaching underrepresented groups (e.g., 45 percent of users are female).

Samuel Lieber

Assistant Professor of Engineering Technology

Samuel Lieber is a university lecturer in the Mechanical Engineering Technology Program in the Department of Engineering Technology at NJIT and an alumnus who earned bachelor's, master's and doctoral degrees in mechanical engineering from NJIT. Dr. Lieber is also a licensed professional engineer in New Jersey with his own practice, which focuses on product and process development in the medical device industry. He contributes to every aspect of product innovation and development from design, to testing, to manufacturing, to inspection. His areas of expertise include medical instruments, implants, tissue-engineered products, and automated manufacturing and inspection processes. As a postdoctoral researcher at the University of Medicine & Dentistry of New Jersey, he designed a bioreactor which allows close study of the effects genes have on the development of heart valves. He later helped design a respiratory assistance device which has since been patented. Dr. Lieber's current research interests include developing novel manufacturing and inspection equipment and processes, establishing industrial collaborations, and developing NJIT's Manufacturing Engineering Technology program.

Title: Advanced Manufacturing Education: Restarting a Bachelor of Science Program That Maintains Continuity From High School to the Workplace

The lack of trained professionals to serve in the Advanced Manufacturing workforce has prompted the restarting of the Bachelor of Science Manufacturing Engineering Technology (MNET) program at the New Jersey Institute of Technology (NJIT). This paper will highlight the unique experiences in restarting the MNET program and updating its course content to meet the current needs of industry. This involved exploring with industry the competencies needed for an Advanced Manufacturing professional and relating them to respective learning outcomes at the high school, associate and bachelor stages of an engineer's education, as well as continuing education in the workforce.

Mengyan Li

Assistant Professor of Chemistry

Mengyan Li comes to NJIT from Rice University, where he was a postdoctoral researcher in the Department of Civil and Environmental Engineering specializing in environmental microbiology and biotechnology. Dr. Li develops water remediation techniques that deploy microorganisms to biodegrade organic pollutants of emerging global concern. He also researches interdisciplinary methods for improving urban water treatment technologies, including the use of nanotechnology to disinfect supplies contaminated with pathogens. To assess the microbial activity in remediation and treatment processes, Dr. Li has developed genetic forensic tools such as a novel biomarker test to evaluate the biodegradation of 1,4-dioxane, a groundwater contaminant. That work won him the Honor Award in the Excellence in Environmental Engineering and Science competition held by the American Academy of Environmental Engineers and Scientists. To date, he has published nine peer-reviewed papers in journals such as *Environmental Science & Technology* and *Water Research*, and he holds a patent for a technique that uses nanomaterials to remove heavy metals from water and sediment.

Title: Genetic Forensic Techniques to Assess the Biodegradation of Priority and Emerging Contaminants at Impacted Nature

Within the last few years, a number of organic contaminants with anthropogenic origin, so-called "emerging" contaminants, have attracted extensive public and scientific attention given their frequent detection and enduring persistency in aquatic environments. Prevalence of 1,4-dioxane, a probable human carcinogen, has been recently reported at thousands of sites within the United States. However, the hydrophilic nature and small molecular size of this compound have precluded effective and economical treatments by conventional physical or chemical alternatives. Recent studies by Dr. Li and others have uncovered the feasibility of removing 1,4-dioxane using microorganisms which can produce specific multicomponent nonheme ion enzymes. He and his colleagues propose to develop multiple genetic forensic techniques enabling rapid and sensitive identification and assessment of such biodegradation processes at impacted nature.

Xiaobo Li

Associate Professor of Biomedical Engineering

Xiaobo Li joins NJIT from the Albert Einstein College of Medicine, where she was an assistant professor in the Departments of Radiology, Neuroscience, Psychiatry and Behavioral Sciences. Her research focuses on developing and applying mathematical techniques to evaluate the structural and functional organization in the human brain to better understand the biological underpinnings of cognitive disorders. Using multimodal Magnetic Resonance Imaging, she examines brain development and disorders associated with Attention Deficit/Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), and schizophrenia, among other conditions. Her goal is to integrate predictive analytical and statistical models that produce quantitative neurobiological criteria with sophisticated neuroimaging techniques to improve clinical diagnoses of cognitive deficits associated with severe brain disorders. Dr. Li has been the principal or co-principal investigator of several major grants, involving multiple institutions in some cases, funded by the National Institutes of Health, among other agencies. Her research has been published in journals such as *NeuroImage* and the *Journal of the American Academy of Child & Adolescent Psychiatry*.

Title: Neural Mechanism of Inattention in Children Post-Traumatic Brain Injury (pTBI)

TBI is a major public health problem in the United States. Attention deficit is one of the most common long-term consequences following TBI, which significantly contributes to poor academic and social performances, and life-long learning. However, the consensus regarding appropriate evaluation and treatment of attention deficit in children post TBI is rather limited, due to the lack of understanding of the neurobiological substrate associated with this syndrome. Dr. Li and colleagues propose to study the neural networks associated with attention deficit in children post TBI, using a model-based approach. They aim to examine the functional thalamo-cortical pathways for visual sustained attention processing in children who have TBI-induced persistent symptoms of inattention, and compare these functional pathways with that in group-matched children with ADHD and controls.

Lu Lu

Assistant Professor of Electrical and Computer Engineering/Mechanical and Industrial Engineering

Lu Lu comes to NJIT from Rensselaer Polytechnic Institute, where he was a postdoctoral researcher at the Center for Automation Technologies and Systems. His research focuses on robotics, human-machine interaction and additive manufacturing, with an emphasis on automatic controls and the optimization of a range of systems. Dr. Lu is particularly interested in control theory and its applications to precision motion control, assistive robotics, unmanned aerial vehicles and 3D printing. He is currently exploring ways to help people with different types of disabilities, including mobility impairments, through the use of robotic manipulators. His research has been published in journals such as *Automatica*, *IEEE Transactions on Control Systems Technology* and *IEEE Transactions on Industrial Electronics*. His recent work, "Human-robot cooperative control for mobility-impaired individuals," received the "Best Session Presentation Award" at the 2015 American Control Conference. He has a related patent pending.

Title: Human-Directed Control of Assistive Mobile Manipulator

People with severe mobility impairment require help from human assistants to manage activities of daily living. Dr. Lu and his colleagues propose a cost-effective robotic solution to assistive living for mobility-impaired individuals. Specifically, a human-friendly robot, Baxter, is installed on a commercially available wheelchair. The entire system is highly redundant, and the human user with mobility issues can use a 3-dof input device, "Jamboxx," to control it. A contrained optimization algorithm is then developed to generate the velocity commands of all the joints of the mobile manipulator, such that the human input is maximally realized while none of the physical constraints are violated. Experiments have been successfully conducted on both free-space object retrieval/placement and contact tasks such as board cleaning and door opening.

Iulian Neamtiu

Associate Professor of Computer Science

Iulian Neamtiu comes to NJIT from the University of California (UC), Riverside where he was an associate professor in the Department of Computer Science and Engineering. His research areas span security, programming languages, software engineering and smartphones, with an overarching goal of making software and mobile devices more secure, efficient, dependable and maintainable. Dr. Neamtiu is the principal developer of Ginseng, the first system to allow widely used server programs to be updated on-the-fly, without restart or reboot. Early on, he received a National Science Foundation (NSF) CAREER award and a University of California Regents' Fellowship, and he has to date secured $2.7 million in funding for his research from various NSF grant programs, the U.S. Army, Intel and Google. He is part of the 10-year Cyber-Security Collaborative Research Alliance between the Army Research Laboratory and five universities. The group's goal is to advance the theoretical foundations of cyber science in the context of Army networks. In 2013, Dr. Neamtiu received the Bravo Zulu award from UC Riverside for his support of military veteran students on several fronts, from counseling and retention, to research engagement, to job placement.

Title: Security and Reliability of Mobile Systems

Mobile operating systems such as Android or iOS have been extremely successful and are powering billions of devices from watches to phones to tablets, as well as cars and drones. While the appeal of mobile devices is understandable, their strengths, such as constant connectivity, computation/storage capabilities and ability to collect physical sensor data, can be subverted: The device can be compromised, its private data such as user's location history, documents or emails can be exfiltrated, and the device can be turned into a base for cyber-attacks. Dr. Neamtiu's group works on improving the reliability and security of mobile devices using an array of techniques: recording-and-replaying app executions to support dynamic analysis and reproducibility; "self-healing" apps that can detect and repair program errors without user intervention; and protecting benign apps from a compromised operating system.

Megan E. O'Neill

Assistant Professor of Humanities

Megan O'Neill comes to NJIT from Virginia Tech, where she was the associate director of the university's Office of First Year Experiences, serving as a member of the vice provost's academic affairs leadership team. In that role, she designed, implemented, and assessed a universitywide curriculum of more than 30 courses aimed at increasing first-year students' academic skills. She will be using these experiences to lead a redesign of NJIT's first-year writing program. With a Ph.D. in rhetoric and writing from Virginia Tech, Dr. O'Neill specializes in research that examines the theoretical foundations of teaching and learning strategies that support the development of critical thinking skills. She has looked closely at how the research methods employed by feminist ethnographers can be applied to enhance the thinking, writing and problem-solving skills of college writers. Her work has been published in journals such as *College Composition and Communication* and she was named one of Virginia Tech's "Emerging Leaders" in 2014.

Title: From Reflection to Reflexivity: An Adaptive Writing Pedagogy for Student Growth and Program Assessment

Writing scholars address self-reflection's role in the writing classroom, but student reflective writing itself has been undertheorized and underresearched, centering mostly on the use of reflective writing as an assessment component of writing portfolios. Using a selection of first-year-student writing, Dr. O'Neill's research contends that traditional reflective writing activities are not enough to move students away from rote reflection and toward critical analysis and recursive thinking. Her research offers an alternative reflective writing pedagogy that focuses on teaching students reflexive (as distinctive from reflective) thinking and writing practices, similar to those used by feminist social science ethnographers.

Bipin Rajendran

Associate Professor of Electrical and Computer Engineering

Bipin Rajendran joined NJIT in the spring of 2016 from the Indian Institute of Technology (IIT), Bombay, where he is currently an associate professor of Electrical Engineering. After completing his Ph.D. at Stanford University in 2006, Dr. Rajendran spent six years as a research staff member at IBM's Thomas J. Watson Research Center developing energy-efficient memory technologies and computing systems inspired by the brain. He contributed to the development of the first nanoscale devices and computing chips that mimic neurons and synapses in the brain. At IIT, his research group has demonstrated new algorithms and systems for learning, music recognition and robotic navigation inspired by biological networks. He co-authored the book, *Phase Change Memory: From Devices to Systems*, and has published more than 50 papers in peer-reviewed journals and conferences. He has been issued 50 U.S. patents. At IBM, he was named a Master Inventor, awarded four high-value patent awards and two technical accomplishment awards.

Title: Intelligent Computing Systems Inspired by the Brain

The new iPhone processor can perform more than 1 billion floating point operations per second (or 1 gigaFLOPS), consuming approximately 1 Watt. The human brain is estimated to be capable of performing an astounding 20 million gigaFLOPS, but consumes a mere 20 Watts. Clearly, nature's methods and engines for information processing are far superior to the best man-made systems today. Dr. Rajendran's research group aims to understand the key architectural principles of the brain and build fundamental devices, algorithms and systems for a new generation of intelligent computing systems.

Cong Wang

Assistant Professor of Electrical and Computer Engineering/Mechanical and Industrial Engineering

Cong Wang comes to NJIT from the University of California, Berkeley, where he has been a postdoctoral researcher and lecturer in the Department of Mechanical Engineering after earning his Ph.D. from Berkeley in 2014. Dr. Wang's research focuses on robotics and control systems with an emphasis on advanced control theories, robotic manufacturing and semiconductor fabrication. He developed a series of data-driven algorithms designed to improve the performance of industrial robots used in manufacturing. His work in applying machine learning and robust optimization in the semiconductor industry, for example, focuses on boosting the capabilities of "frog-leg" robots, allowing the ubiquitous wafer-handling machines to produce more silicon chips at a lower cost. He is currently researching hypermaneuverability robotic manipulation to automate delicate manufacturing processes in sectors such as consumer electronics, work that can now be performed only by skilled workers. Dr. Wang has been working closely with industry partners such as the Silicon Valley-based Applied Materials and FANUC, the world's largest industrial robot supplier.

Title: Data-Driven Control Techniques for Robotic Manufacturing

Robotics is playing an important role in the new era of manufacturing industry. Recent market trends such as the renaissance of auto economy and the boom of smart devices require extreme manufacturing capabilities. Dr. Wang and his industrial partners have developed a series of unconventional control techniques using data analytics and nonparametric artificial intelligence to handle various emerging control challenges in robotic manufacturing, ranging from sensory prediction to skill perception. These techniques enable new robotic manufacturing applications, such as demonstrative robot teaching, human-robot collaborative operation and next generation IC fabrication.

Chase Q. Wu

Associate Professor of Computer Science

Chase Q. Wu joins NJIT from the University of Memphis, where he was an associate professor in the Department of Computer Science. His research interests include big data, high-performance networking, parallel and distributed computing, sensor networks and cyber security. He develops data transfer mechanisms to help users in a wide spectrum of scientific domains move big data efficiently and reliably over long distances for collaborative data-processing analytics. He works in particular on optimizing the performance of large-scale scientific workflows in heterogeneous network environments. The workflow system he developed has been used for processing big data in scientific applications such as climate modeling. Dr. Wu's work has been supported by numerous funding agencies, including the National Science Foundation, the U.S. Department of Energy, the U.S. Department of Homeland Security and Oak Ridge National Laboratory, where he is a member of the research staff and works on projects involving networking and big data. He has published more than 165 research articles in journals such as *IEEE/ACM Transactions on Networking* and *IEEE Transactions on Knowledge and Data Engineering*.

Title: Enabling Big-Data Computing Workflow in High-Performance Networks

Many applications are producing colossal amounts of data, now frequently termed as "big data," which calls for end-to-end computing solutions to facilitate data transfer, processing, visualization and analytics. Such solutions are typically built upon data- and network-intensive workflows comprised of computing modules with complex dependencies. The goal of Dr. Wu's team's research is to develop an integrated and automated workflow solution to support big-data applications in high-performance networks. This talk provides a brief tutorial on big-data scientific applications and shares their research results on various enabling technologies based on rigorous algorithm design, theoretical dynamics analysis and real network implementation, deployment and evaluation.

Haisu Zhang

Assistant Professor of Marketing

Haisu Zhang comes to NJIT from Purdue University, Calumet, where he was an assistant professor of marketing at the College of Business. He specializes in marketing strategy with a focus on innovation and new product development. Dr. Zhang is currently researching ways to optimize the success of product development teams by enhancing the role that marketing plays, especially in its interactions with engineering. He is also exploring emerging methods for motivating individual investors for new product development, such as crowdfunding. His work has been published in the *International Journal of Research in Marketing* and the *Journal of Product Innovation Management*, and he is a member of the editorial review board of the *Journal of eCommerce Business*. Dr. Zhang has earned high marks for teaching. A student team he mentored recently won the national championship in the Next Generation Undergraduate Market Research Competition sponsored by GfK, the fourth largest market research firm in the world.

Title: Crowdfunding: Is It About You or Is It About Me?

The authors conduct three empirical studies to examine two types of intrinsic motivation, other orientation and self-orientation, and their effects on the backer's funding decision on new product projects at the crowdfunding platform. In line with the altruism versus egoism contrast, this research finds that self-orientation has a stronger positive effect than other orientation on the backer's funding decision. Furthermore, the authors examine the difference between men and women, and find that the relationship between other orientation and funding decision is stronger for women than men, but the relationship for self-orientation is stronger for men than women.

Faculty Seed Grant Recipients

Tara Alvarez
Professor of Biomedical Engineering

Marc Sequeira
University Lecturer of Computer Science

Title: Novel 3D Virtual Reality Gaming Platform to Administer Vision Therapy for Children with Concussion

Binocular dysfunctions are common in the general population where 1 out of 20 children have difficulty converging their eyes (sustained vision at near such as when you read a book). Patients suffer from double and blurred vision. The prevalence in brain injury patients is even greater at about 50 percent. While vision therapy is effective in 75 percent of patients to remediate symptoms, it can be costly and require significant time. Home therapies are not as effective as office therapy due to poor patient compliance. This project seeks to develop a gaming platform to rehabilitate the visual system. The premise of the game is to create a fun, interactive suite of games where a child will converge his/her eyes on different 3D images to stimulate different vergence angles for varying amounts of sustained fixation. Future work includes comparison of the therapeutic efficacy of this gaming platform to conventional vision therapy protocols.

Yi Chen
Associate Professor of Management and Henry J. Leir Chair in Healthcare

Cristian Borcea
Associate Professor of Computer Science

Title: A Study of the Interdependency between Online Article Recommendation and Online Ad Revenue

In this project, we study how to develop big-data technologies for online advertising, which saw $121 billion in spending in 2014. This project is in collaboration with Forbes Media, a renowned business publisher. The goal is to develop technologies that improve article recommendation of publishers in order to improve user experience and to increase publishers' ad revenue. Dr. Chen and Dr. Borcea have performed some preliminary studies on viewability prediction of online display ads with promising results.

Shawn Chester
Assistant Professor of Mechanical and Industrial Engineering

Martina Decker
Assistant Professor of Architecture

Title: Adaptive Building Technology Through Smart Materials

Shape Memory Alloys are polymorphic smart materials that are known to respond to fluctuations in temperature with a change in shape. These materials can operate devices without the need for electricity, sensors or conventional motors. Dr. Decker and Dr. Chester are investigating these emergent materials for zero-energy adaptive building technologies and how they can enable advanced thermoregulation in building skins. The proposed material system is designed to respond to seasonal fluctuations in ambient thermal conditions but could also be used to respond to the unpredictable nature of a changing climate.

Christopher Funkhouser
Professor of Humanities

Title: Expressive and Documentary Interactive Audio in Humanities
As mediated communications expand, exploring new trajectories with sound has become Dr. Funkhouser's primary activity as a researcher. Digital audio invites many useful types of engagement, and engineering sound in public settings is his particular focus. This research pursues use of digital media for purposes of working effectively with audio in static (documentary) or kinetic (participatory) realms. Using innovative interface and coding techniques (e.g., HTML5, JavaScript), he has pioneered methods of presenting interactive and layered audio on the World Wide Web; using MIDI (Musical Instrument Digital Interface), he has developed methods by which to use musical instruments to activate word and image on computer screens. This demonstration features examples of these preliminary experiments with interactive sound technology.

James Geller
Professor of Computer Science

Yehoshua Perl
Professor of Computer Science

Christopher Ochs
Assistant Professor of Computer Science

John Cays and Burcak Altin
College of Architecture and Design

Title: Abstraction Network Browser for Biomedical Terminologies With User Interfaces (UI) for Beginners and Experts Based on User Experience (UX) Principles
The UI/UX project has two major goals: (1) For the first time, use sound architectural visual-design principles in implementing visualization software for biomedical terminologies, leveraging centuries of experience in the architecture field for visual displays. (2) Develop two separate user interfaces (UI), a beginner's interface and an expert interface, for the software tool in (1) that provide different user experiences (UX). The project builds on two existing systems developed at NJIT with the objective to make them more user-friendly by employing novel UI/UX solutions and knowledge-visualization techniques. The larger issue this project tackles is one that is relevant to many fields in today's – and tomorrow's – worlds: a generic system that will be used to create and visualize different kinds of knowledge networks, resulting from big-data research, making them accessible to users.

Jorge Golowasch
Professor of Biological Sciences

Casey Diekman
Assistant Professor of Mathematical Sciences

Title: Role of Ionic Current Co-Regulation in Circadian Activity of Gonadotropia-Releasing Hormone-Secreting Cells

Circadian (~24-hour) rhythmicity is vital to many essential functions (sleep/wake, alertness, metabolism, fertility, etc.), but the mechanisms that generate the electrical activity required to sustain these rhythms are still poorly understood despite decades of research. The goals of this project are to develop the protocols and gather preliminary evidence to test the hypothesis that gonadotropin-releasing hormone (GnRH) neurons express ion channels in a manner that is both circadian and correlated. To identify correlations, a pure population of identified neurons is required to avoid contamination of neurons that express different phenotypes. Thus, Dr. Golowasch and Dr. Diekman plan to apply a battery of experimental and computational techniques on a monoclonal GnRH cell line known to express circadian properties but has not been proven to express ion channels in a circadian pattern.

Theresa Hunt
Assistant Professor of Humanities

Title: Visible Divides: Investigating Race and Culture in Women's Experiences in Academic STEM

Despite their projected increase in enrollment in American universities, women of color are likely to remain a disproportionately small number of STEM professionals in academe and industry. Various interventions to broaden participation have been implemented within the last decade, but few focus on two crucial areas related to this population. Recent research (N=35) suggests first that, community college transfer pathways are a common entry point for this population and can create unique obstacles. Second, self-created peer networks organized around nonacademic identities (i.e., faith and national origin) were identified as more relevant to academic success than support mechanisms offered within the institution. Both findings warrant further research to better understand the experiences and priorities that impact retention.

Dong-Kyun Ko
Assistant Professor of Electrical and Computer Engineering

Title: Paper Thermoelectrics: Merging Nanotechnology with Naturally Abundant Fibrous Material

We are entering an era in which capturing minuscule amounts of energy from the surrounding can power small devices to perform extraordinary tasks. Among various energy-scavenging methods, thermoelectric power generation stands out as a powerful technology as it can directly produce electrical power from waste heat ubiquitously present around us. Maximizing the utilization of heat available in natural and man-made environments is central to enable efficient power generation. Thus, improving the thermal contact to heat sources of arbitrary geometry is crucial. However, bulk thermoelectrics are rigid, brittle and costly to produce. Dr. Ko's research group proposes to merge thermoelectric nanomaterials tailored for efficient energy conversion with naturally abundant cellulose paper that can lead to flexible thermoelectric modules at a substantially reduced cost.

Alice (Eun Jung) Lee

Assistant Professor of Biomedical Engineering

Title: Strategies for Developing Next-Generation Engineered Cardiovascular Tissue

The primary research interest of Dr. Lee's laboratory is to develop therapeutic strategies for cardiovascular repair. Various in vitro cardiovascular tissue models are developed using integrated use of stem cells, biomaterial scaffolds and biomimetic bioreactors. Recently Dr. Lee and her colleagues have shown biocompatibility of PVDF-TrFE scaffolds, which exhibit piezoelectric properties with pluripotent-stem cell-derived cardiomyocytes as well as functional improvement of cardiomyocytes on conductive graphene nano-composite scaffolds. A custom biaxial stretching device has been developed to better understand the biophysical cues necessary during cardiovascular and microvascular formation in engineered tissues. Moreover, tissue-specific endothelial cells have been derived to formulate new therapeutic angiogenic approaches for cardiovascular disease as well as for diabetes treatment.

Eon Soo Lee

Assistant Professor of Mechanical and Industrial Engineering

Title: Point of Care (POC) Micro Biochip for Cancer Diagnostics

The early detection of cancers can enhance curability of the disease and finally improve the quality of life for patients. Cancer antibodies with enhanced specificity and affinity are specially developed and ligated in the microchannel of biochip. When the blood sample flows in the microchannel over the cancer antibody, the cancer antigen from the blood forms antigen-antibody complex. This antigen-antibody interaction is captured using state-of-the-art sensing technology which is developed using sophisticated nanocircuit design in the biochip. Therefore, we can diagnose both the cancer and its severity using the microbiochip, using both qualitative and quantitative results of the sensing technology.

Mohamed A. Mahgoub

Associate Professor of Engineering Technology

Title: Extending the 90-Minute Mixing Time Cap for Ready-Mixed Concrete

Currently, a 90-minute rule exists that limits how long a concrete mixture can stay in a concrete ready-mix truck before being discharged. As traffic and road congestion in urban environments has gotten progressively worse, this rule has become more difficult to meet. When concrete stays in the mixing truck longer than necessary, it must be disposed of, resulting in construction and demolition waste, increased greenhouse gas emissions and increased costs to the suppliers. This work presents new research into the impact of extending this time limit to 180 minutes. Impacts on concrete strength and long-term durability are presented and discussed.

Richard O. Moore

Associate Professor of Mathematical Sciences

Title: Methods of Learning Uncertain Flows Using Optimal Control

Dr. Moore and his team are developing a mathematical framework that will allow a cohort of controlled autonomous vehicles to effect near-optimal, efficient sampling of the velocity field that dominates their transport. Until now they have focused on simple linear flows that produce velocities exceeding the maximum speed of the gliders, but are extending their methods to more complex flows including those observed in oceanic and tank environments. They will validate their methods using autonomous robotic vehicles transported by customizable flows in an experimental tank at Drexel University's multirobot Coherent Structure Testbed (mCoSTe), with ground-truth measurements provided by particle imaging velocimetry and other flow sensors.

Gelu Nita

Associate Research Professor of Physics

Title: Interactive Multi-Instrument Database for Studying Solar Flares

Solar flares are a primary source of powerful geomagnetic storms, high-energy radiation and particles that affect the Earth's space environment and technological and biological systems. The flares are observed in the whole range of electromagnetic radiation spectrum, from radio to gammarays, by numerous space missions and ground-based observatories. Dr. Nita's team has developed a multi-instrument database implemented as an interactive Web page that allows researchers to identify and match data from various sources to specific flare events for given time intervals, and obtain complete information about the events. The database provides an important tool for investigation of the flare physics and development of physics-based forecasts. This work is supported by the NASA grant NNH14ZDA001N-HGIand NJIT startup grant.

Bryan Pfister

Associate Professor of Biomedical Engineering

Title: A New Approach in Studying Neuronal Circuit Dysfunction From Blast-Induced Traumatic Brain Injury

Every 15 seconds, someone suffers a traumatic brain injury (TBI). Head injury from motor-vehicle accidents, falls, sports and national defense affect about 1.7 million people nationally. Of the 5.3 million Americans with TBI, most are coping with a mild-to-moderate injury. Mild injuries to the brain do not show the overt tissue damage present in severe cases, imaging cannot reveal injury and diagnoses are missed or uncertain. Many people, however, often return to work despite a perceived mild concussion and go on to show pervasive neurological, cognitive and emotional changes that greatly impact their everyday life. The dilemma is, compared to severe forms of TBI, little is known about the consequences of mild TBI on neuronal structure, function or potential for repair. This seed grant will be used to establish a state-of-the-art electrophysiological model to precisely measure unique alterations in neuronal circuit function and the ability to generate normal electrical activity. Using brain slices from mildly to moderately injured rats, Dr. Pfister and his colleagues will identify and describe injury-induced alterations in excitation and inhibition of hippocampal synaptic circuits and determine how local changes in synaptic and cellular properties collectively alter macroscopic circuit function. To accomplish these research goals, a multielectrode array system (MEA64, Multi Channel Systems) will be used to test the hypothesis that mild to moderate TBI causes malfunction of regional endogenous hippocampal microcircuits that conglomerate into overall dysfunction of the hippocampal trisynaptic circuit.

Andrei Sirenko

Assistant Professor of Physics

Title: Synchrotron Radiation-Based Ellipsometry for Study of Lattice and Magnetic Dynamics in Oxides

Synchrotron radiation at Brookhaven National Lab, NSLS and NSLS-II, is applied for studies of lattice dynamics in magnetic oxides using ellipsometry. The polarization analysis is based on the Mueller matrix formalism. Dr. Sirenko and his colleagues are developing a new ellipsometry setup with a spectral range that extends from THz up to midinfrared parts of the electromagnetic spectrum. The results for the optical phonons in multiferroic oxides, such as rare-earth orthoferrites and rare-earth ferroborates-are presented for the low temperature ranges that include the magnetic-phase transitions. The new experimental setup will be installed and used as a multiuser facility at NSLS-II.

Dimitri Theodoratos

Assistant Professor of Computer Science

Title: Exploiting Novel Database Optimization Techniques to Efficiently Mine Patterns From Big Tree Data

Finding interesting patterns that are hidden in large loosely structured datasets (trees and graphs) has many practical applications, since it allows capturing the complex relationships that exist among the different data entries. Over the years, mining has evolved from mining-induced patterns to mining- embedded patterns. However, because of mining's complexity, current approaches fail to mine homomorphic patterns from large data sets. In this project, novel algorithms for extracting homomorphic tree, graph and generalized graph patterns from large tree and graph data will be designed. Dr. Theodoratos' team approach will leverage techniques for encoding tree data and twig-join algorithms for optimizing tree-pattern queries over tree-structured databases.

Antai Wang

Associate Professor of Mathematical Sciences

Title: A New Estimate of Baseline Hazard Function in Bivariate Frailty Models

Dr. Wang and her team study the properties of a special class of frailty models. A useful formula for baseline hazard functions for this class of frailty models is established, and a new estimator for baseline hazard function in bivariate frailty models is proposed based on dependent censored data with covariates. The variability of their estimator is comparable with that of the Breslow estimator (see Breslow 1972). Furthermore, it can also serve as a diagnostic tool to check the fit of corresponding frailty distributions. They fit a leukemia data set using their model and end their paper with some discussions.

Guiling Wang
Assistant Professor of Computer Science

Jo Young Lee
Assistant Professor of Computer Science

Title: Real-Time Path and Destination Prediction by Leveraging Smart Phones
The proposed project aims to empower vehicles with smart-path and destination-prediction capability by leveraging smart phones. Empowering vehicles with smart path and destination prediction can greatly improve the efficiency of the transportation system and alleviate or address many transportation problems. For example, the knowledge of future destinations and traveling paths can bring customized location- and path-based information to users. The service will render benefits to both individual users and the transportation system as a whole. In this project, efficient and effective data structures and algorithms will be developed to achieve the real-time prediction and will be prototyped on Android phone platforms.

Xianqin Wang
Associate Professor of Chemical, Biological and Pharmaceutical Engineering

Title: Carbon Dioxide Conversion into C1 Chemicals Using Novel Photocatalytic System
A key player in the global warming issue is carbon dioxide (CO2) gas. Carbon capture and conversion is to capture CO_2 and convert it into useful products such as formic acid and methanol. This provides the opportunity to transform CO_2 from an environmental threat to an economic resource while also facilitating the closing of the carbon cycle. CO_2 will serve as a feedstock to fuels that will replace current fossil fuel without changing the fossil-fuel economy. In this study, we are investigating a novel photocatalytic system to convert CO_2 to C1 chemicals using an N-substituted organic-based catalyst.

Andrzej Zarzycki
Associate Professor of Architecture and Digital Design

Zhi Wei
Associate Professor of Computer Science

Title: Interconnected and Autonomous Building Assemblies
The use of distributed sensors and microcontroller platforms in architecture facilitates new, responsive building systems with intelligent façades and user- and context-aware behaviors. Future adaptive architecture will integrate information technologies with distributed sensing, redefining building-component behaviors and performance to address emerging resiliency and zero-energy needs. This research proposal focuses on adaptive and autonomous assemblies through design and technology development and implantation. It investigates how building facades and other building components can be interconnected into a network of interactive and autonomous agents with data sharing and cross-actualization. The research project outcomes will include design and development of data-producing and data-driven building components that aim to outperform current inert structures/designs.

Notes