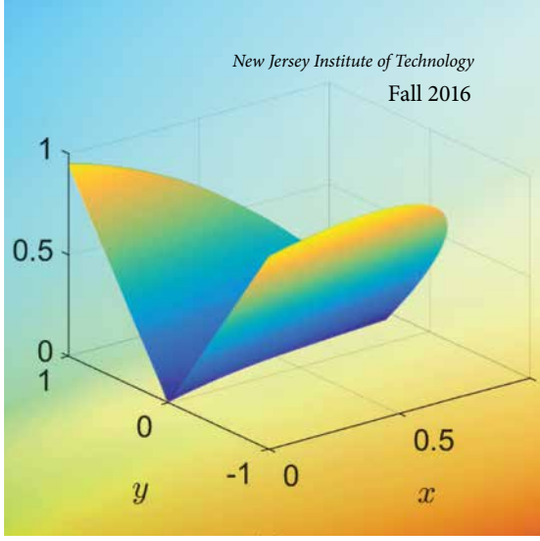


NJIT
New Jersey Institute of Technology

A world-class technological research university

$121 MILLION

in research expenditures in fiscal year 2016,
which represents a

56% INCREASE

2006–2016

Designated an

INNOVATION & ECONOMIC PROSPERITY UNIVERSITY

spurring regional economic development

in 2015 by the Association of Public and Land-Grant Universities

Mehau Kulyk/Science Source

Safeguarding security and privacy for app users

The use of mobile apps — software that runs on smartphones, tablets and electronic wearables — is surging. The 1.4 billion active Android device users worldwide now have access to more than 2.2 million apps in the Google Play store. But how are users to know if an app jeopardizes their confidential information?

Work on smartphone security to date has focused mostly on malicious apps. By contrast, **Iulian Neamtiu,** NJIT associate professor of computer science, studies how "good" apps can compromise users' data privacy by interacting with "bad" or questionable websites. His analysis of 13,500 popular, free Android apps verified by outside parties for trustworthiness showed that nearly 9 percent communicate with malicious websites, 15 percent communicate with websites flagged for malware, viruses, phishing and other scams, and 74 percent communicate with sites containing material unsuitable for children.

Dr. Neamtiu and his team have developed a systematic approach and comprehensive tool to assess app security and privacy concerns. Its usefulness extends to individuals downloading apps as well as marketplaces offering Android apps. It could also be deployed as one component of a larger cybersecurity system.

Probing more deeply to treat profound hearing loss

Despite major advances and new technologies, hearing-aid users and individuals with cochlear implants still struggle to hear in settings with high levels of background noise. That's why NJIT's **Antje Ihlefeld**, an assistant professor of biomedical engineering in the university's Newark College of Engineering, is reframing the problem. Rather than approaching it strictly as a disorder of the ear, Dr. Ihlefeld is investigating hearing loss and the role the central nervous system plays in processing sound.

Dr. Ihlefeld's research, which gets its data from cochlear implant users and a biological model, looks at two key aspects: how the brain operates when exposed to a cacophony of background sounds, and how the central nervous system functions when totally deprived of sound. The upshot of Dr. Ihlefeld's research promises a greater understanding of the system deficits among the hearing impaired and, more immediately, new hearing-remediation strategies.

Using biophysics to engineer entirely new materials

Camelia Prodan, associate professor of physics at NJIT, was recently awarded a $1 million science and engineering research grant by the W.M. Keck Foundation to investigate the mechanics of microtubules — protein tubes that are central to the structure of a cell as well as a number of cellular processes. Dr. Prodan's co-principal investigator on the grant is her husband, Emil Prodan, a physics professor at Yeshiva University.

Combining theoretical physics, mathematics and biology, Dr. Prodan and her colleagues explore the vibrational energy that moves across the surface or edge of a cell's microtubules.

The team's research, which uses mathematics and a computational lab to model complex constructs, promises to shed light on issues such as how chemotherapy drugs work in targeting the structure of cancer cells. Dr. Prodan's findings may also lead to a range of practical applications like metamaterials with novel properties and functionalities, such as bullet-proof shielding that disperses the shock along the surface of the material and away from the deeper layers protecting the body.

Revolutionizing radar with compressive sensing

Alexander Haimovich leads research teams at NJIT working to enhance the performance of radar systems and develop reliable wireless communications for high-speed trains.

Most recently, Dr. Haimovich and his colleagues are focusing on applying "compressive sensing" algorithms to multiple-input multiple-output (MIMO) radar systems. An emerging field, compressive sensing promises to revolutionize defense, weather and geo-mapping radar systems by supporting high-resolution imaging while simultaneously reducing computer processing demands and lowering power consumption. Compressive sensing also holds enormous promise for signal-processing-intensive applications ranging from video and medical imaging to remote surveillance, spectroscopy and genomic data analysis.

A pioneer in the field of signal processing in adaptive arrays and multiple sensor radar, Dr. Haimovich is distinguished professor of electrical and computer engineering at NJIT and holder of the Ying Wu endowed chair. He is also director of the internationally recognized Elisha Bar-Ness Center for Wireless Communications and Signal Processing Research at NJIT.

Top left: Carol and Mike Werner/Science Source. Inset: Henning Dalhoff/Science Source

Recognizing Outstanding Researchers and Educators: NJIT Faculty Members Garner Two More CAREER Awards

Earlier this year, two NJIT professors, Alexei Khalizov, far left, and Casey Diekman, were awarded five-year grants through the National Science Foundation's Faculty Early Career Development (CAREER) Program, bringing the total number of CAREER awards to NJIT faculty to 21.

The CAREER Program offers the foundation's most prestigious and most sought-after awards in support of young faculty who, in building their academic careers, have demonstrated outstanding potential as both educators and researchers.

Dr. Khalizov, assistant professor of chemistry and environmental science, will use the award to develop a better understanding of atmospheric mercury — the highly toxic pollutant released by fossil fuel combustion and waste incineration — and how it migrates into the food chain through the contamination of soil, oceans and other bodies of water.

Dr. Diekman, assistant professor of mathematical sciences, uses mathematical tools and models for studying the circadian rhythms that synchronize our behavior with the daily cycle of light and dark, and with seasonal change. The grant will help him develop new tools and a deeper understanding of the biology underlying jet lag.

New Jersey Institute of Technology

2016 EXCELLENCE IN RESEARCH AWARD WINNER

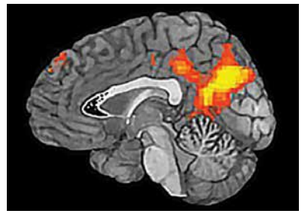
Rajesh Davé, distinguished professor of chemical, biological and pharmaceutical engineering at NJIT, is a problem-driven inventor whose work on re-engineering tiny particles is relevant to the pharmaceutical, food, electronics and energy industries and has earned him a stream of patents and awards. In October, he received one of NJIT's highest accolades, the 2016 Excellence in Research Prize and Medal.

Dr. Davé, who also is director of NJIT's New Jersey Center for Engineered Particulates, received his ninth patent last year for a manufacturing process for coating fine particles less than the diameter of a human hair that does not require water, organic solvents or heat. The technology has been licensed by a global health care company that develops drugs and their delivery systems.

"Raj's applications-focused approach has resulted in transdisciplinary collaborations that are changing the future of manufacturing," said Atam Dhawan, NJIT's vice provost for research. "In the area of pharmaceutical engineering, his success in making medications the body can absorb and process efficiently has advanced one of the primary goals of the National Institutes of Health: to design therapies that are more precise."

Delivering Vision Therapy via Virtual Reality Gaming

Tara Alvarez and **Marc Sequeira** are applying immersive virtual reality gaming technology to vision therapy. The researchers have devised a suite of fun, interactive 3-D virtual reality games that deliver clinical therapy techniques tailored to different age groups and various vision problems. The work is especially relevant to the 5 percent of children and 40 to 50 percent of traumatic brain injury patients who suffer from eye movement disorders that affect their ability to see, read, learn and work at near distances. The novel therapy will supplement office treatments and encourage patients to adhere to recommended regimens at home.



Mapping the Brain

Bharat Biswal is an internationally renowned researcher recognized for mapping the brain's activity using an advanced noninvasive technique called functional magnetic resonance imaging (fMRI). He helped create the 1000 Functional Connectomes Project, which gathers fMRI data from around the world. This open resource for mapping and understanding brain function aims to help clinicians detect autism, schizophrenia, bipolar disorder and traumatic brain injury at an earlier stage and to understand the impact of different forms of therapy.

Developing New Mathematical Techniques

Brittany Froese specializes in the development of computational methods for solving challenging mathematical problems that arise in science and industry. Her work has far-reaching implications for a number of applications, including mapping the earth's surface, detecting oil reserves, designing lenses to control lasers, predicting the weather and processing medical images.

Investigating a More Sustainable Concrete

Matthew P. Adams and **Matthew Bandelt** are investigating more sustainable, environmentally friendly alternatives to concrete — the mixture of sand, gravel and small rocks combined with cement and water that is one of the world's most widely used construction materials. Production of concrete consumes an enormous quantity of natural resources and releases significant amounts of damaging greenhouse gases. By using alternative cements and recycled concrete aggregates, the two are pursuing solutions that would provide compressive strength and long-term durability.

Creating More Intelligent Computing Systems

Bipin Rajendran draws inspiration from the human brain. Studying the key architectural principles used in learning, memory and computation, he seeks to build new nanoscale devices, algorithms and systems that more closely mimic these higher order neural functions. Applications for his bio-inspired intelligent computing include complex decision-making scenarios, such as health care diagnoses and autonomous navigation systems.

Research Snapshots

Transforming Cloud Computing Technology

Xiaoning Ding seeks to improve memory virtualization technology — cloud computing and other virtualized platforms that make up the backbone of the modern computing infrastructures used by industry, military, academia and the wider population. With funding from the National Science Foundation, Ding's research would enable applications on these platforms to work better, consume less energy and be more reliable. The resulting research framework and techniques will be open to the community for sharing.

Exploring Smart Materials for Smarter Buildings and More Resilient Cities

Martina Decker, an environmentally concerned architect with a keen interest in technology, collaborates with colleagues in other disciplines at NJIT to explore new and emergent materials. Sometimes engineered at the nanoscale, these smart materials can change their size and shape, store and release water, generate or conduct electricity, or change color in response to fluctuations in temperature. Transferred to architecture and the constructed environment, these materials will be crucial for more sustainable, climate-resilient cities.

Improving Clinical Care Practices in New Jersey

Backed by a $49.6 million grant from the U.S. Department of Health and Human Services, **New Jersey Innovation Institute** (NJII) — an NJIT corporation that applies the intellectual and technological resources of the university to challenges identified by industry partners — is working with medical practices in the state to improve the quality and efficiency of the care they provide, while also lowering costs. The Practice Transformation Networks (PTN) program will transition 11,500 clinicians from a fee-for-service model to a value-based reimbursement system that compensates providers for keeping their patients well through ongoing, evidence-based disease management. The effort is expected to generate $250 million in health care savings.

New Jersey Innovation Institute
An NJIT Corporation

Advancing Manufacturing

Cong Wang and his industrial partners are using data analytics and artificial intelligence to develop control techniques that address new challenges in robotic manufacturing such as sensory prediction and skill perception. Industrial robots are pervasive in the manufacturing of autos, metals, semiconductors, electronics, plastics, food, pharmaceuticals and consumer goods. In engineering the next generation of robotics, these techniques will enable advanced robotic manufacturing applications including teaching robots through demonstration, human-robot collaborative operations, and advanced integrated circuit fabrication.

New Jersey Institute of Technology

211
U.S. patents

97
additional patent applications pending

89
new faculty have joined NJIT in the last five years

373
doctoral degrees awarded 2011–2016

Q&A

Fadi P. Deek

NJIT Provost and Senior Executive Vice President

Fadi P. Deek was appointed NJIT provost and senior executive vice president in June 2013. He received his bachelor's in computer science from the university in 1985, his master's in 1986 and his Ph.D. in 1997.

What is NJIT's strategic vision with respect to research?

NJIT's current strategic plan, *2020 Vision*, emphasizes that national and international prominence in research is integral to our university's mission. We are fostering curiosity-driven research by individual faculty members and a multidisciplinary team culture critical for the success of programs that can improve the quality of life for people around the globe. NJIT researchers are at the forefront of initiatives that include investigating how solar physics and space weather impact our planet; developing new technologies for clean energy and water purification; understanding and treating brain injuries; advancing tissue engineering and regenerative medicine; innovatively strengthening cybersecurity; and mining large data sets for new insights into human behavior.

To date, how has NJIT progressed toward making the vision you have outlined an institutional reality?

By at least one key indicator, we are doing very well. We are on track to double our external research expenditures by 2020. Universitywide collaboration for research is giving rise to new multidisciplinary centers of excellence for sustaining this growth — research institutes that bring together diverse talents to address complex problems. The first, the Institute for Brain and Neuroscience Research, will be launched this year.

What are the challenges, perhaps even unexpected, that NJIT has encountered in implementing this vision?

Working toward far-reaching goals would not be exciting without challenges — for example, providing all of the infrastructure needed to advance the research of the nearly 90 new faculty members hired over the last five years. In addition to meeting physical requirements specifically related to research and continuing faculty growth, we are dedicating more resources to general campus improvement. We must also be prepared to support creative proposals in research and education that present themselves unexpectedly.

To what extent has NJIT succeeded in building relationships with industry and government to identify critical research and ensure funding?

Given NJIT's historic orientation toward applied science and technology, partnering with industry and government to address social challenges and spur economic growth is natural for us. But this requires an effective mechanism for synchronizing the discovery of new scientific knowledge with creating practical applications for industry and solving problems important to government.

NJIT's New Jersey Innovation Institute is a prime example of our leadership in promoting regional and global development. This NJIT corporation is facilitating major, jointly funded projects that focus the resources of private and public groups, along with those of the university, on formulating solutions needed in health care delivery, biotech and pharmaceutical production, defense and homeland security, civil infrastructure, and financial services.

How is NJIT integrating research initiatives with the university's educational mission?

The reality for our students is that comprehensive understanding of the research process and hands-on research experience are essential for the greatest career success. Increasingly, funding agencies such as the National Science Foundation are emphasizing the national importance of integrating student engagement in the research initiatives they support.

As affirmed by *2020 Vision*, we are committed to maximizing the value of studying at NJIT through learning that links applied research and knowledge acquired in the classroom. We have made this linkage a priority for our faculty, who are working to achieve this objective in the context of a curriculum designed to increase opportunities for undergraduates and graduate students to participate in research. We are also increasing the number of curricular-based co-ops and internships that enhance the real-world knowledge and skills our graduates need to be leaders in research for industry and government.