

67

new faculty hired in the last four years to expand research and meet the needs of the growing student population



Joan Banks-Smith

Developing new therapies and assistive technologies

An estimated 5.5 million Americans require long-term help with daily activities as a result of a stroke, spinal cord injury or muscular dystrophy. In response, NJIT's Rehabilitation Engineering Research Center on Wearable Robots, led by Associate Professors **Richard Foulds** and **Sergei Adamovich**, is improving therapies and developing new assistive technologies to increase independent mobility and manipulation for people with neuromuscular disabilities. Funded by the U.S. Department of Health and Human Services, the center's translational research takes discoveries in the lab and applies them to studies with individuals.

A collaborative effort with the Kessler Foundation is exploring a way to allow individuals to use their hands or "walking fingers" to control and power the walking motion of a motorized exoskeleton attached to their legs. The tactile sensation of the leg movement is then conveyed back through the hands, providing essential feedback to the user. Another project is studying the benefits of advanced robotics and virtual reality in enhancing neural learning and functional recovery of arm and hand control in people with stroke. In the words of Dr. Foulds, the center is doing "engineering that will affect people with significant limitations, that is intended to either enhance their rehabilitation or help them accommodate their disabilities so they can lead more independent lives."



Cutting costs, saving time and managing traffic

The 2015 Urban Mobility Scorecard puts the cost of traffic congestion in the U.S. at \$160 billion annually. That includes 3 billion gallons of wasted fuel and 7 billion extra hours of commuter drive time. Two of the most gridlock-plagued roads are in the N.J./N.Y. metro area, and New York-Newark pays the highest cost in the nation for congestion and loses the most hours in delays.

These fundamentals drive the research of **Lazar Spasovic**, who is the director of NJIT's Intelligent Transportation Systems Resource Center and one of the country's top experts in the field of intelligent transportation management. Research by Dr. Spasovic and his team at NJIT aims to help New Jersey transportation leaders use technology and big data to manage traffic more intelligently, implement "smart" road networks, and give drivers real-time and predictive information to aid decision-making. By capturing live streams of granular data on traffic speed and volume on roads throughout the state, Dr. Spasovic, also a professor of civil and environmental engineering at NJIT, hopes to use the information superhighway to unclog real-world roadways.



\$19.6 MILLION

new 24,500-square-foot, state-of-the-art Life Sciences and Engineering Research Resource Center underway

Exploring the impact of human-computer interaction

The numbers speak volumes: 4.1 billion smart phones sold since 2007. Over 1.4 billion active Facebook users. An estimated 93 million Candy Crush players glued to the screen every day. Fun facts, but also signals of the shift in social interactions and behavior as a result of the human-computer relationship.



Tracking this new reality is **D. Yvette Wohn**, head of NJIT's Social Interaction Lab and assistant professor in the College of Computing Sciences. Dr. Wohn's research helps reveal what's happening to us as individuals, on a massive human scale. It probes the connection between psychological well-being and technology usage. It examines "relationship loneliness" and looks at Facebook use and college adjustment among first-year students. It asks what motivates people to continue to interact with technology over long periods of time; how technology habits are formed; and what social and psychology consequences we might expect to see.

Recognized primarily for its research into technology's impact, the Social Interaction Lab is also committed to applying its findings to develop new social- and media-related applications to nourish and improve mental health.

Engineering tiny particles to produce big breakthroughs

The work of NJIT's **Rajesh Dave** spans disciplines. A distinguished professor of chemical, biological and pharmaceutical engineering, Dr. Dave's research has led to faster-burning rocket fuels, safer weapons, and better and more efficiently made products as disparate as cement, cookies, fuel and sunscreen. No work, however, has been more important than his effort to make more targeted and precise medications.

A pioneer in re-engineering tiny particles, Dr. Dave's research today focuses on enhancing the effectiveness of drug therapies — for example, by increasing the absorption rates of drugs with poor water solubility, by delaying the release of medications that degrade in the acidic environment of the stomach, and by masking bitter tastes to make drugs more palatable.

Last year, Dr. Dave received his ninth patent for a manufacturing process to coat fine particles that does not require water, organic solvents or heat. Developed with former NJIT students who are also named on the patent, the technology has been licensed by a global health care company. The coating in this instance is a fine layer of wax that will be used to mask bitter tastes.

Tracking solar storms and space weather to protect planet Earth

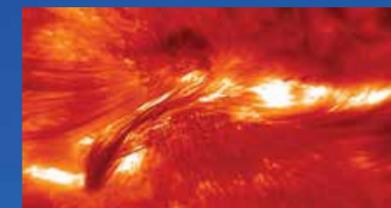
Accurate and timely weather forecasts have long been one of the science community's holy grails. Now the study is extending to "space weather."



Haimin Wang, distinguished professor of physics at NJIT and director of the university's Space Weather Research Lab, is one of the world's foremost authorities on solar flares. As chief scientist at NJIT's Big Bear Solar Observatory in California, Dr. Wang leads a team dedicated to understanding the physics of solar flares and coronal mass ejections. Just as importantly, the team applies that knowledge to predict solar storms that endanger astronauts and have the power to destroy satellites, power grids and telecommunications networks.

Last spring, Dr. Wang and his colleagues at Big Bear, which is site of the world's largest solar telescope, produced the first high-resolution images of the flaring magnetic structures known as solar flux ropes at their point of origin in the Sun's chromosphere, allowing scientists to distinguish between mild twists and those severe enough to cause space weather. These observations provide an unprecedented glimpse into the complex dynamics of the Sun's multilayered atmosphere, as well as insights into the massive eruptions on the star's surface.

Since joining NJIT in 1995, Dr. Wang and his team have been awarded more than \$26 million in federal research grants. He leads NASA's \$4 million effort to study solar flare dynamics in the lower atmosphere, and he heads a global network of more than 30 scientists in six countries who monitor space weather 24/7.



Observations with the 1.6-meter telescope at NJIT's Big Bear Solar Observatory in California, the most powerful ground-based instrument for studying the Sun, provided the first-ever high-resolution images of solar flux ropes.



PROFESSOR BATTLES BOTS, EARNS 25TH PATENT

Defending websites from malicious intruder bots is not unlike fighting viruses: neutralize them and they reinvent themselves, finding new ways to penetrate. But IT security designers still hold an advantage over some automated programs masquerading as people. To date, there are human abilities too complex to imitate.

Exploiting that weakness is central to an Internet security technology developed by **Nirwan Ansari**, distinguished professor of electrical and computer engineering, and two of his former NJIT students, who have devised a new method for distinguishing humans from computers. Their next-gen CAPTCHA — the brief test for computer users to access a website — requires viewers to identify text, but presents it in video animation rather than in the distorted, static letters currently used. Relying on a unique human ability to connect images, the new test is easy for people to pass but difficult for machines.

Dr. Ansari's technology earned him his 25th patent since 2000, the year he received his first for an algorithm to control digital data relay congestion and alleviate gridlock in a fair, fast manner.

Using ISS as a Microgravity Lab

Boris Khusid, working with several of his NJIT colleagues and NASA astronaut Donald R. Pettit, used the International Space Station (ISS) as a lab to explore the behavior of charged water droplets in a microgravity environment. Their research — including development of an important new technique for controlling the shape of a fluid droplet before it becomes a spray — could lead to better inkjet printers, more precise techniques for manufacturing polymer fibers and improvements in mass spectrometry.



Tapping Into a Swarm's Collective Intelligence

Simon Garnier and members of his Swarm Lab study the mechanisms underlying the coordination of large animal groups, such as ant colonies or human crowds, and how this can lead to the emergence of "intelligent" and "less intelligent" group behaviors. Their work has applications to complex problems such as the organization of pedestrian traffic or the control of robotic swarms.

Waking Up Coffee Farmers to Better Pricing Strategies

Junmin Shi studies Kenya's coffee industry, looking at whether small-scale coffee farmers can use inventory management to thrive financially in the face of unpredictable coffee supplies and wide price fluctuations. By applying mathematical modeling and theory to the real-life practices of Kenya's 700,000 small-scale coffee farmers and the five million people they support, Dr. Shi's research may contribute to the U.N. Millennium goal of eradicating extreme hunger and poverty in Africa.



Investigating Biological Timekeeping

Jet lag and night shifts have long played havoc with human health. Now Casey Diekman, funded by the National Science Foundation, is using mathematical modeling to study electrical activity in the brain and the role this plays in circadian timekeeping, especially in response to natural light/dark cycles.

Mining Social Media to Reveal Cancer Risks

Songhua Xu, assistant professor of information systems at NJIT, is leveraging the power of online content and social media, e.g., Foursquare check-ins and location-stamped Facebook posts, to explore and possibly reveal the relationships between geographic locations and diseases like cancer. The research is funded by a \$1 million grant from the National Institutes of Health.



specialized laboratories and research centers

\$49.6M AWARDED

to the university's New Jersey Innovation Institute (NJII) to help physicians improve care, lower costs and increase patient access to medical information



+\$76 million in NSF awards since 2005

\$102M 200,000 sq. ft.

new state-of-the-art Wellness and Events Center

Research Snapshots



Assuring Biomedical Information Quality to Support Researchers and Physicians

Researchers and medical professionals worldwide depend on vast, shared, continually growing and evolving repositories of biomedical information where quality, consistency, organization and accessibility are paramount. Two NJIT computer scientists, Yehoshua Perl and James Geller, have been awarded a three-year, \$1.75 million federal grant to support their research work on quality assurance of families of biomedical ontologies. Ontologies, or the common terms and vocabularies used by researchers, are increasingly important to support interdisciplinary research, information retrieval and knowledge management.



Lighting the Way With New LEDs

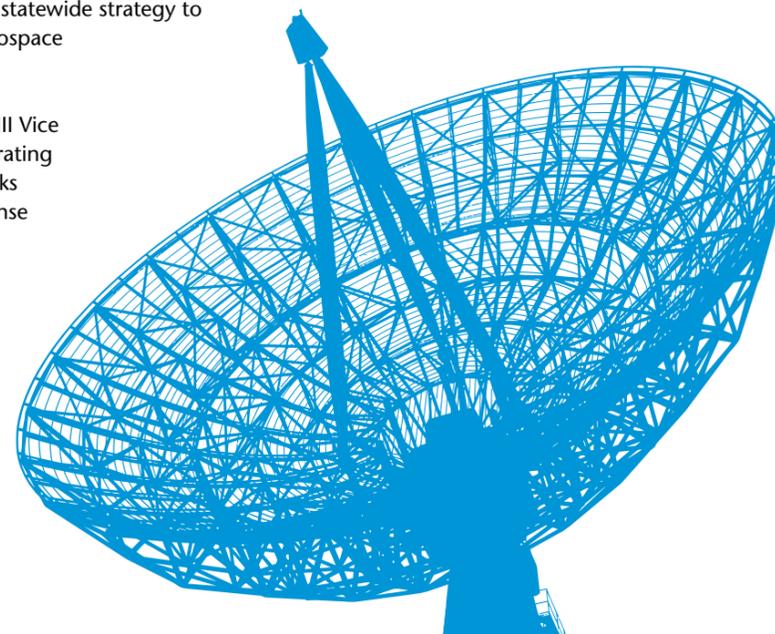
Standard LED lights consume 90 percent less power than incandescent bulbs. But now Hieu Pham Trung Nguyen is taking LED design and production to a new level by exploring the use of nanomaterials that can be precisely manipulated at the atomic level. This research seeks to eliminate LED reliance on costly phosphorescent rare-earth materials and aims to generate light directly at different parts of the visible spectrum.

Strengthening N.J.'s Aerospace and Defense Supply Chain

Backed by a \$5.67 million grant from the Department of Defense, 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 focused on a statewide strategy to support New Jersey's aerospace and defense industry.

NJ MarketShift, led by NJII Vice President and Chief Operating Officer Tim Franklin, works with aerospace and defense contractors in the state to improve their competitiveness,

penetrate new markets, develop new products and grow their business. NJ MarketShift also helps community leaders and policymakers by providing powerful web-based applications to improve regional planning and economic development.



Q&A

Joel S. Bloom

NJIT President



NJIT's President, Joel S. Bloom, Ed.D., was honored as 2015 Educator of the Year by the Research & Development Council of New Jersey.

What are the most significant characteristics of research and development at NJIT?

We are focused on a complementary balance between basic and applied research. That's critical for the discovery of basic knowledge and translating that knowledge into real-world applications — better processes and innovative products.

How has NJIT's research program evolved in recent years?

One key metric is our increasing research expenditures, which now place NJIT fifth among all U.S. polytechnic universities. Structurally, we created the office of vice provost for faculty and student-led research to advance our programs internally and the New Jersey Innovation Institute (NJII) to apply research in partnership with industry, government agencies and other universities.

The evolution of our research foci has resulted in a strategic commitment to multidisciplinary research and education in three areas vital for the well-being of the global community — integrating engineering and the life sciences, data science and information technology, and sustainable systems. As part of this commitment, we have made significant investments in tenured and tenure-track faculty with attendant expertise in our three focus areas, state-of-the-art research facilities and increasing the number of Ph.D. students.

Is there increasing cooperation with groups outside of academia?

As research at universities such as NJIT becomes increasingly committed to scientific and technological innovation, it is equally important to understand the needs of our community, commerce and industry. It's a relationship essential for focusing R&D in order to sustain economic development and improve our quality of life. NJIT's primary function is to create these relationships and enable the ecosystem for innovation and development.

Does a growing emphasis on research complement NJIT's educational mission?

Research has long been a traditional part of graduate study. At NJIT, participating in research is also viewed as a milestone experience for undergraduates, with increased public and private funding for a growing range of programs. These include a summer research program that most recently engaged more than 150 undergraduate students.

Such engagement fosters awareness of how new scientific and technological knowledge can lead to quality-of-life improvement. As we hear from our younger alumni, hands-on learning, working on interdisciplinary research teams, capstone projects and other similar experiences significantly enhanced the value of their education at NJIT as preparation for their careers and success as scientists and engineers.

What do you see as your greatest challenges in research and development, and how is NJIT meeting those challenges?

There are two challenges. One is recruiting top talent. The other is providing facilities where talented researchers can flourish. We are fortunate in both respects at NJIT.

The 67 new faculty hired under our "2020 Vision" strategic plan are all experts in their fields. A key to our recruiting success is that we offer opportunities to contribute to the well-defined, well-supported multidisciplinary initiatives we have launched to address the challenges of improving health, advancing digital technology, and making sustainability a reality.

Thanks in large measure to support from the State of New Jersey, physical change at NJIT is keeping pace by providing the state-of-the-art facilities needed for these R&D efforts. With assistance that includes funding from the "Building Our Future" bond act — the largest higher-education facilities bond act ever approved in our state — we are moving ahead with major renovations and new construction dedicated to research, teaching labs, design studios, makerspaces and team workspaces.

Stories of Innovation

njit.edu/storiesofinnovation

University Heights • Newark, NJ 07102-1982 • 973.596.3220