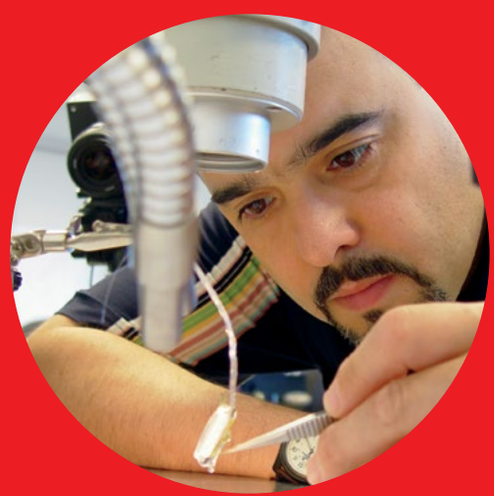
New Jersey Institute of Technology
Spring 2016

NJIT
New Jersey Institute
of Technology

A world-class technological research university



TOP 10

among public technological universities
in faculty scholarly productivity

according to *Academic Analytics*

45% INCREASE

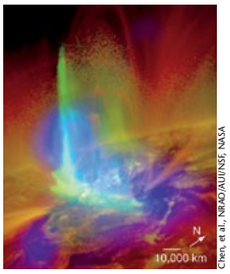
in external academic research awards
over the past two years

Researching ways to protect our water supply

Devastating droughts in the West, oil spills in the Gulf, lead-laced drinking water in Flint, Mich. Every story has lent greater urgency to the work of NJIT researchers developing technologies and processes to protect America's water quality and supply.

NJIT Professor **Michel Boufadel,** an international expert in water contamination and director of NJIT's Center for Natural Resources Development and Protection, is working with members of the oil industry to improve spill preparedness and response capabilities. His previous work included technical analyses and remedial strategies related to the cleanup of the Deepwater Horizon and Exxon Valdez oil spills. **Kam Sirkar,** who holds 28 patents and is a distinguished professor of chemical engineering, is applying innovative membrane-separation technologies to improve water-desalination processes and to remove pollutants from industrial runoff. And **Mengyan Li,** assistant professor of chemistry, is developing water remediation techniques that deploy microorganisms to biodegrade organic pollutants. His research also seeks ways to improve urban water-treatment methods by using nanotechnology to disinfect supplies contaminated with pathogens.

Identifying the source of the Sun's accelerated energy



Chen, et al., NRAO/AUI/NSF, NASA

One of the central mysteries of solar flares is how these explosions produce radiation and accelerate particles to near light speed within seconds. The most powerful flares release magnetic energy equal to the force of millions of hydrogen bombs. The threat for our tech-based society is obvious: energized particles with the power to penetrate Earth's atmosphere, knock out satellites and take down power grids.

The research of **Dale Gary** and **Bin Chen** examines the physics behind solar flares, focusing on the elusive structure known as "termination shock," believed to play a key role in converting released magnetic energy from flares into kinetic energy in accelerated particles. Through observations of a long-lasting solar flare captured by a radio telescope, the two NJIT scientists have demonstrated the structure's role in accelerating particles. Dr. Chen used millions of images captured by the Jansky Very Large Array in developing a technique to visualize shock dynamics. NJIT's own radio telescope, the Expanded Owens Valley Solar Array in California, at left, will become the first solar-dedicated array equipped with this new imaging capability.

Waterframe/Alamy

Reverse-engineering the biomechanics of nature

Brooke Flammang, an assistant professor of biology in NJIT's College of Science and Liberal Arts, is following in the footsteps of the Swiss engineer who invented Velcro after studying the burrs that stuck to his clothing during a walk in the woods. Dr. Flammang is focusing on the remora fish, specifically the biological mechanism on the remora's head that enables it to grip onto the bodies of fast-moving hosts, then release quickly when survival necessitates.

By studying the disc-shaped feature that enables the remora to latch onto the varied surfaces of sharks, rays, dolphins, sea turtles and even other remoras, Dr. Flammang's team in the Fluid Locomotion Laboratory discovered a complex mechanism that includes a modified fin structure with tiny spikes that generate friction to adhere to the host.

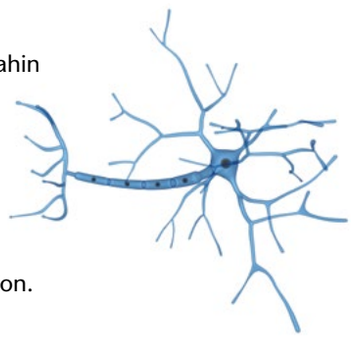
Understanding the mechanics of this process could help researchers and engineers create designs for a range of devices that stick well and release easily, including pain-free bandages and tags for tracking endangered species that are less harmful than barbs and more effective than suction alone.

Extracting motor signals from the spinal cord

Since the 1970s, a brain-computer interface — technology that uses neural signals to communicate with electronic devices — has been pursued as a way to restore function in people with disabilities resulting from injuries to the central nervous system, such as spinal cord injury, traumatic brain injury and stroke. Despite years of research, significant challenges remain.

In search of a solution, **Mesut Sahin,** a pioneer in the field of neural engineering and chief investigator at NJIT's Neural Prosthetics Laboratory, is studying the spinal cord as an alternative site for an electronic interface. Dr. Sahin's research seeks to extract volitional motor signals from an area of the spinal cord above the site of injury. In recent animal studies, he and his colleagues have succeeded in not only capturing brain signals from the cervical spinal cord, but showing the signals' correlation to limb movements.

Another line of research by Dr. Sahin and his colleagues is the use of electrodes and alternative methods to stimulate the airway muscles of people suffering from obstructive sleep apnea, a condition that affects up to 6 percent of the world's population.



Harnessing big data to create usable, high-value information

Big data has enormous value — but only if the proper tools exist to process, organize, analyze and unlock the riches residing in these dense, ever-expanding troves.

The volume and diversity of data generated on a daily basis is growing exponentially. Information gathered from computers, smartphones, satellites, sensors, microprocessors and other sources has the potential to reveal valuable and actionable insights.

In health care alone, analytics of big data could change every inch of the nation's $3 trillion health care industry. The payoff would be enormous: better patient outcomes, greater transparency, and more accessible and affordable care. That's why the research of **Yi Chen**, associate professor in both NJIT's Martin Tuchman School of Management and College of Computing Sciences, is vital. Dr. Chen's work is focused on harnessing social media and online health care forums to create patient-centered tools to help patients, caregivers and doctors while also enabling researchers to discover and generate new knowledge. With the sponsorship of The Leir Charitable Foundations, Dr. Chen is also bringing together top researchers, policymakers, and business and tech leaders. Her overarching goal is to galvanize action and identify the challenges, opportunities and future directions of big data as it relates to improving health care.

On another front, Associate Professor of Computer Science **Chase Wu** is working to tame the explosion of information and increase the productivity of scientists using big data. Currently, scientific applications typically generate terabytes of simulation or experimental data — all of which must be stored, managed and often transferred to different geographical locations for processing and analysis — overwhelming scientific computing and network infrastructures. With funding from the U.S. Department of Energy's Office of Science, Dr. Wu is designing and developing easy-to-use computing and networking toolkits for the complex workflows in these high-performance environments.

CYBER SOLUTIONS FOR THE DEPARTMENT OF DEFENSE

Associate Professor of Computer Science and Director of the NJIT Cybersecurity Research Center, **Kurt Rohloff** is leading an NJIT team on the PALISADE project, a multiyear, multimillion-dollar effort that is part of the SafeWare program funded by the Defense Advanced Research Projects Agency (DARPA) and the Army Research Office.

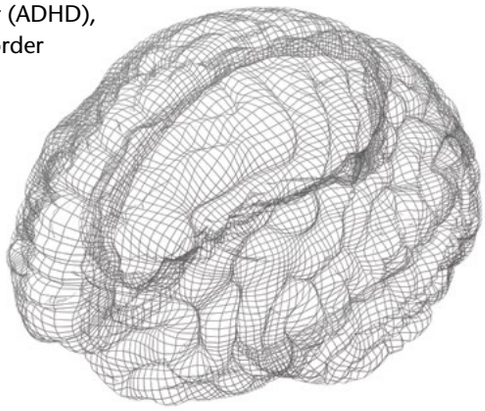
DARPA's game-changing SafeWare cybersecurity program aims to develop encrypted computing technologies, address software security limitations and protect proprietary software. Dr. Rohloff's team includes two MIT professors, a Turing Award winner, a University of California, San Diego professor and Raytheon BBN Technologies, a top research and development firm.

The PALISADE project has received more than $750,000 in funding and is eligible for up to $3.5 million. Project funding comes on the heels of Dr. Rohloff's recent work on other DARPA projects and NJIT's recent designation by the National Security Agency and Department of Homeland Security as a National Center of Academic Excellence in Cyber Defense Education.

The growing portfolio of cybersecurity activity broadens the university's research in this vital area.

Searching for Biomarkers of Cognitive Deficits

Xiaobo Li is working at the intersection of neurobiology and neuroimaging to better understand the biological underpinnings of cognitive disorders. As director of the Computational Neuroanatomy and Neuroinformatics lab at NJIT, her goal is to integrate predictive analytical and statistical models with sophisticated neuroimaging techniques in order to improve clinical diagnoses of cognitive deficits associated with Attention Deficit/ Hyperactivity Disorder (ADHD), Autism Spectrum Disorder and schizophrenia, among others.



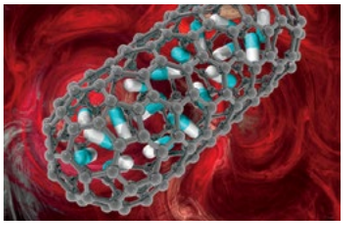
Accounting for the Human Element

Ming Fang aims to increase the effectiveness of accounting practices in conveying information to shareholders, regulators and others. Her current research looks at the impact of social connections among managers from different firms on accounting practices such as earnings management and tax avoidance. She studies a range of topics within empirical accounting, including financial reporting, tax evasion, fraud and regulation, corporate innovation and corporate governance.

Exploring Ethical and Practical Implications of Science Policy

Are scientists and engineers who receive federal or state research grants obliged to address societal needs or can they pursue knowledge for its own sake? Should funding agencies institute a "societal impact" requirement and, if so, how would they implement it? These are just two issues surrounding research ethics and accountability in the science-society relationship that Britt Holbrook investigates. His work has far-reaching implications for policymakers and the increasingly globalized research enterprise.

Research S

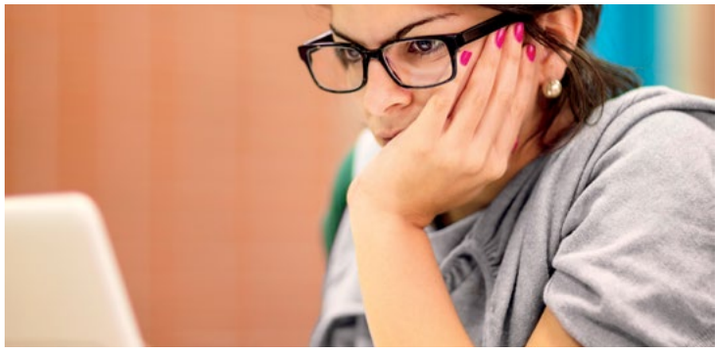


Combating Neurological Disease

Xiaoyang Xu, a specialist in novel biomaterials and nanotechnologies, has teamed up with James Haorah, an expert in brain biology, to improve the treatment of crippling neurological disorders. New therapies for diseases such as Alzheimer's and Parkinson's have been only partly effective to date because they are unable to penetrate the brain's protective membrane to reach the central nervous system. The researchers propose encapsulating drugs inside a nanoparticle equipped with a set of chemical tools to "unlock" the membrane by altering its surface.

Interpreting Cultural Expression in Architecture

Architectural historian Zeynep Celik studies how politics and ideologies shape cities and influence architecture. Her most recent work, awarded a $100,000 prize, shows for the first time that the late Ottoman Empire was a force in the rise of modernity, a cultural development traditionally attributed strictly to Western thought and influence. In January, the School of Engineering and Architecture at Ghent University honored Dr. Celik with the George Sarton Medal, which recognizes outstanding historians of science in the international scholarly community.



Building a Next-Gen Search Engine for Learning Support

With funding from the National Science Foundation, Vincent Oria and other computer scientists at NJIT and partner universities are developing ways to make course content more organized, interactive and accessible. A specialist in multimedia databases, Dr. Oria's research will enable students to easily search information-rich multimedia course materials — including textbooks, slides, and audio and video content — to find specific subject matter. With the ultimate aim of improving learning, the technology and methodology could enable a truly interactive, individualized curriculum that assembles course materials based on learning styles and other personalized needs.

Detecting a Deadly Cancer

Eon Soo Lee and Bharath Babu Nunna are developing a microbiosensor chip to diagnose ovarian cancer without any external equipment. The chip consists of microchannels with specially designed flow patterns coated with antibodies and novel sensing technologies. Cancer antigens in the blood pass through the channels, where they are detected both quantitatively and qualitatively, accurately diagnosing the cancer along with its development stage. If their work proves successful, the microchip could enable unobtrusive, cost-effective early detection of this deadly cancer.

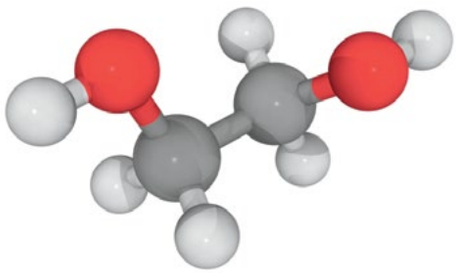
Aiding Recovery from Injury

Research projects in Gal Haspel's lab focus on neural connectivity, activity and recovery from injury and, ultimately, could help individuals recover from neurological damage, including spinal cord injury. He and his colleagues are studying the neurobiology of locomotion in the nematode *C. elegans*, a transparent round worm that was the first multicellular organism to have its entire genome sequenced and the only organism to date with its neural connections or "wiring diagram" so thoroughly mapped.

napshots

Making Smart Gels Smarter

Polymeric gels are increasingly ubiquitous and used in everything from contact lenses to oil-well seals. Smart gels that respond to stimuli such as changes in temperature, pH and ion concentration are being developed for applications as varied as drug delivery, biomedical sensing, tissue engineering and hydraulic fracturing. Despite their huge, sector-spanning potential, little is known about how these gels perform in complex, real-world settings outside of the lab. Shawn Chester, an expert in materials behavior, is providing engineers with the simulation tools to test smart gels in particular applications so they can be used with confidence and deliver on their highly anticipated promise.



Advancing 5G Mobile Networks

Osvaldo Simeone and colleagues at NJIT's Elisha Yegal Bar-Ness Center for Wireless Communications and Signal Processing Research are addressing the challenges posed by the next generation of mobile networks. Dr. Simeone is leading a team developing enabling technologies, and transmission models and protocols, for mobile cloud computing.

$3.4M

licensing revenues from patent activity over the last decade

3,120

master's and doctoral candidates

+85%

success rate for businesses in NJIT's high-tech and life sciences business incubator

Q&A

Atam P. Dhawan

NJIT Vice Provost for Research

Atam P. Dhawan, distinguished professor of Electrical and Computer Engineering, was appointed vice provost for research at NJIT in July 2015. He has published more than 215 articles in refereed journals, books and conference proceedings. He is a fellow of the National Academy of Inventors (NAI), American Institute of Medical and Biological Engineering (AIMBE), and Institute of Electrical and Electronics Engineering (IEEE).

Today, who are the stakeholders in research at NJIT and other academic institutions?

For a long time, the faculty, their students and research-funding agencies were considered the primary stakeholders. However, the broader community that ultimately benefits from academic research has always been a "silent" stakeholder.

Although previously present in a back seat, the community is gaining full recognition as a research partner. This is so because university-based research must now engage all interested parties in the community — including other researchers and institutions, industries and government agencies — if we are to promote scientific discovery and successfully address economic and social needs.

Does the community engagement you describe represent significant change in the academic research environment?

It does. Given the resources required, universities alone cannot initiate and sustain the highest-quality research without embracing the needs of the external community and focusing on research that meets those needs.

Accordingly, we must continue to build new pathways connecting the university and the community. There must be a seamless link leading from basic research to real-world innovations, and to validation of those innovations in support of community progress.

How do students participate in research today at NJIT, and how do they benefit from the evolving character of research?

Our students will eventually apply their knowledge in the real world. So they must be prepared to participate in research that effectively connects the university with the community.

At NJIT, this preparation begins as early as sophomore year through programs encouraging students to develop entrepreneurial concepts into functional prototypes, and which invite evaluation of those prototypes by advisors from the public and private sectors. Engagement with the community also benefits graduate students, since community funding for research allows us to increase graduate enrollment, including Ph.D. candidates.

What is NJIT doing structurally to accommodate the changing nature of research?

As the community has become a participating partner in setting research priorities, NJIT has integrated community input into its strategic plan for addressing real-world needs in four key sectors. These are sustainability, life sciences and engineering, data sciences and information technology, and transdisciplinary areas. Further, within these sectors, the community has helped NJIT identify more than a dozen specific areas of relevant research.

NJIT is also establishing formal liaison groups to ensure timely, effective communication with the community. In every respect, our goal is seamless collaboration between researchers and the community for improving our quality of life, and for assuring the funding needed.

What more must NJIT, as well as other schools, do to promote productive research?

Along with the community partnership I have emphasized, we must foster cooperation with other universities and research institutions so that we work together to meet community needs, which cannot be achieved individually today. NJIT is already advancing this collaboration in association with schools such as Rutgers and Princeton.

Connecting researchers with the community also requires an "open research" environment integrating the capabilities of multiple institutions. Proprietary interests must be considered, of course. But this can be done in ways that benefit each collaborating institution. An open, shared-resource environment is essential for investigating complex scientific questions and developing credible solutions that work in the real world, in the community. This is critical for scientific progress, economic growth and social improvement.

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