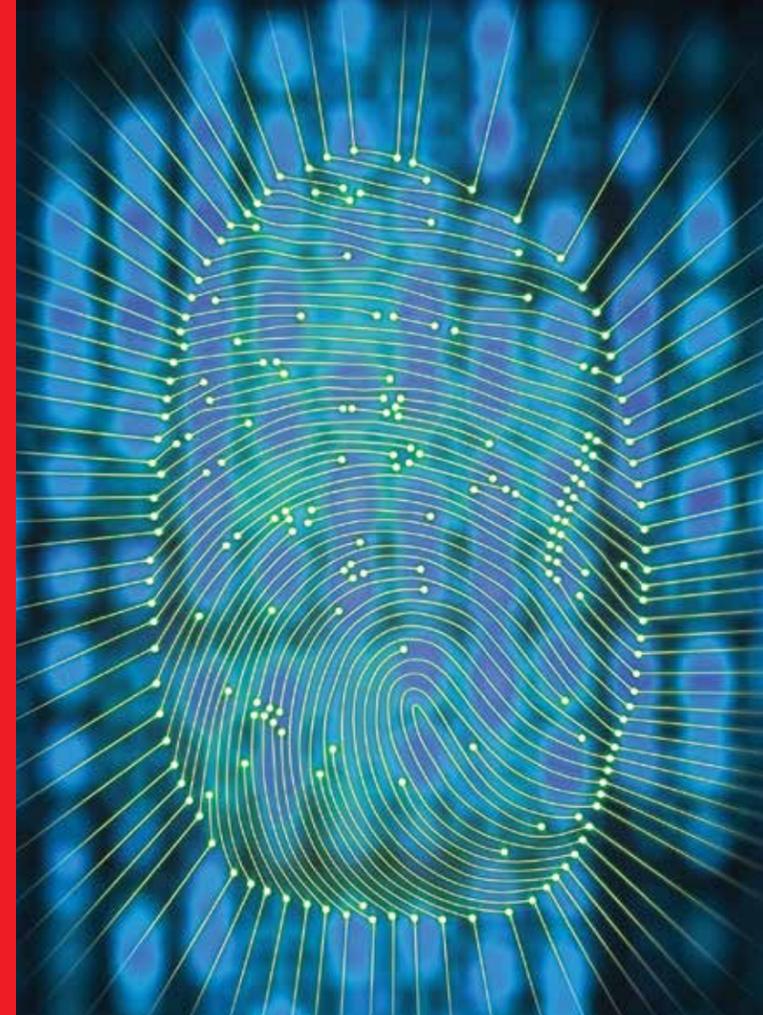


**\$110** MILLION  
in annual research expenditures

TOP **1%**  
nationally for ROI among  
public universities

– PayScale.com

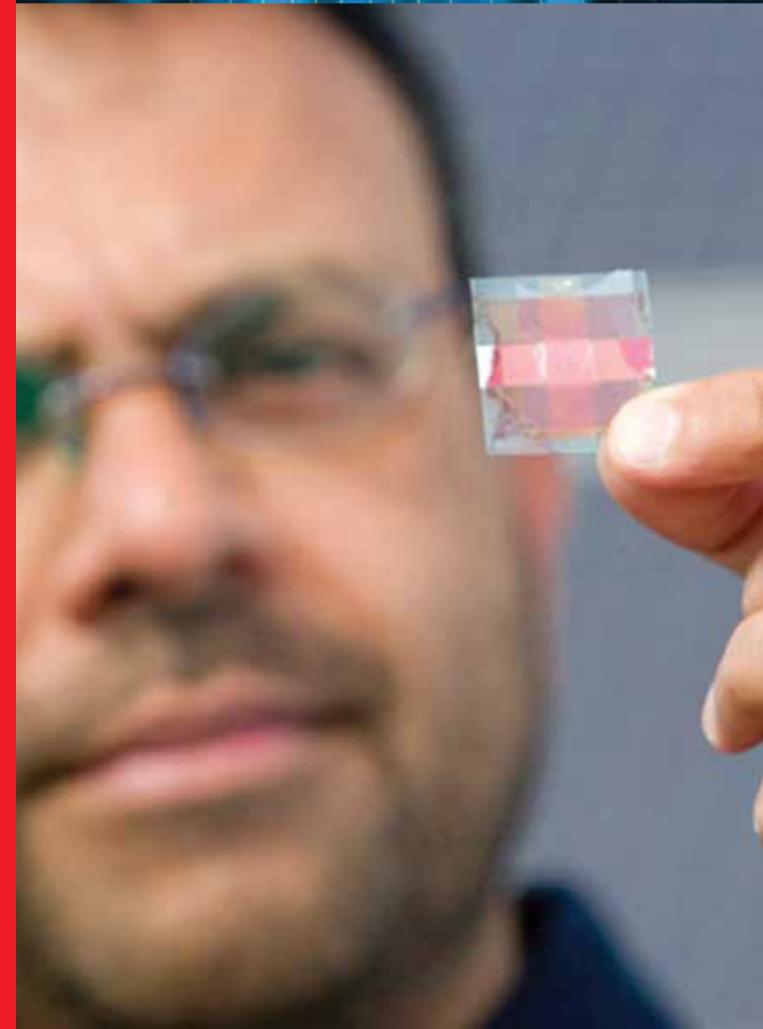


## Developing new lines of defense in cybersecurity

Sony, Target, Facebook, U.S. Central Command — all have been victims of high-profile hacks. But these are just the tip of the iceberg. Last summer, President Obama put the estimated global cost of cybercrime and economic espionage at \$1 trillion annually — which is why researchers at NJIT’s College of Computing Sciences and elsewhere are accelerating efforts to combat the threats.

Before joining NJIT, Associate Professor **Kurt Rohloff** served as a contractor for DARPA. Now, as director of NJIT’s CryptoLab, he’s developing and applying practical methods for a new family of encryption schemes called Fully Homomorphic Encryption (FHE). In simplest terms, the technology enables encrypted data to be passed to and processed by a third party, such as a cloud host, without ever being decrypted. This will enable privacy-sensitive enterprises like healthcare and financial services to cut costs by confidently outsourcing large parts of their IT infrastructure.

In the area of remote sensing, NJIT Associate Professor **Guling Wang** and her colleagues are working on ways not only to encrypt data but also to detect whether the data collected by sensors — for example, from a battlefield — has been altered or replaced by misleading “disinformation.”

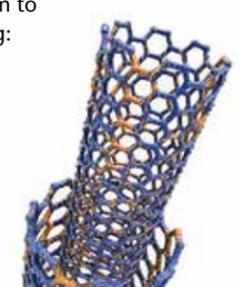


## Dreaming “green” depends on thinking very small

Imagine photovoltaic panels you can print from your desktop. Or solar-sensitive house paint that powers your lights and heats your home. Or batteries you can flex like plastic. These are just a few of the innovations that have come from the lab of **Somenath Mitra**, distinguished professor of chemistry and environmental science at NJIT’s College of Science and Liberal Arts.

A pioneer in the use of nanotechnology for “green” applications, Dr. Mitra also runs one of the world’s leading research groups that develop technologies to measure trace air pollutants in real time. He has developed a variety of air-monitoring techniques for parts-per-billion-level measurements in ambient air and industrial stacks — innovations critically important both commercially and in environmental monitoring.

Dr. Mitra’s recent innovative use of microwaves to purify and functionalize carbon nanotubes has earned him a national reputation. It’s also spurred him to begin thinking about the next big thing: the potential environmental impact of “nanowaste” as the creation, use and disposal of nanomaterials grows.

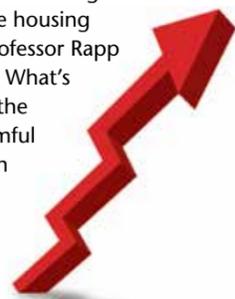




## Investigating the hows and whys of financial bubbles

Homeowners lost more than \$7 trillion of wealth when the housing bubble burst in '07. The Dotcom bubble wiped out 78 percent of the Nasdaq Composite's value in the '90s. And the Dutch tulip bubble's collapse left behind a colorful trail of financial ruin as early as the 1600s. At NJIT's Leir Center for Financial Bubble Research, the focus is on developing a better understanding of this "bubble" phenomenon. Why do financial bubbles develop? How do we predict them? And, most importantly, how do we deal with the economic mess created when they burst?

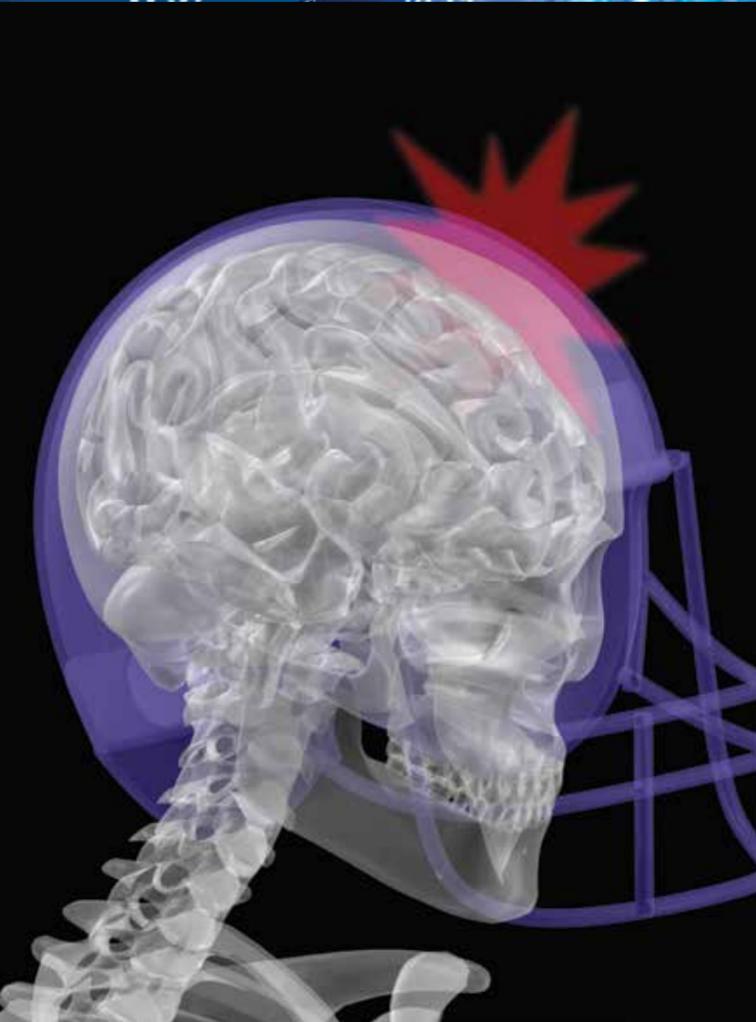
Professor **William Rapp**, director of the Leir Center at NJIT's School of Management, is dedicated to answering these questions. One of the few to warn of the housing bubble's dangers well before it burst, Professor Rapp sees an increasing incidence of bubbles. What's more — and somewhat surprising — is the question of whether all bubbles are harmful to the same degree, and whether certain bubbles have a redeeming aspect.



## Tackling the plague of traumatic brain injuries

An estimated 5.3 million Americans live with a disability caused by a traumatic brain injury (TBI). Researchers in NJIT's Department of Biomedical Engineering are responding with a comprehensive program to gain knowledge, develop therapies and improve protective technologies.

Associate Professor **Bryan Pfister** is exploring how TBI evolves from the cellular level to the systems level, where it causes vision, speech and motor dysfunction. His work will be aided by the Center for Injury Biomechanics, Materials and Medicine directed by Professor **Namas Chandra**. This new facility will recreate TBIs under various conditions using biological samples and dummy heads. Professors **Bharat Biswal** and **Tara Alvarez** are seeking a reliable biomarker for concussions by testing NJIT hockey players, recording blood oxygen levels in different parts of the players' brains and measuring eye movements. Their ultimate goal is to create a portable device to measure the severity of TBI and determine whether an athlete is at risk if sent back into the game.



## Rebuilding smarter and stronger after the devastating impact of Superstorm Sandy

Superstorm Sandy caused \$70 billion in economic losses, but the storm has also unleashed a burst of smarter, more resilient design innovations for the future.

At the forefront of this work is NJIT's Center for Resilient Design, housed at the university's College of Architecture and Design. Established immediately post-Sandy, the Center conducts research and serves as a clearinghouse for expertise, ready-to-build designs, case studies and best practices. The Center is accessed by state and local leaders, business owners and residents living in areas especially vulnerable to flooding and storms.

Key players in post-Sandy recovery work include **Thomas Dallessio**, director of the Center for Resilient Design, and **Michel Boufadel**, who heads research for the Center and is a professor of civil and environmental engineering. Within hours of the end of Hurricane Sandy, Dr. Boufadel received a Rapid Research Response Grant from the National Science Foundation to study the storm's impact on coastal ecosystems and the best ways to restore New Jersey's beaches.

In addition, Associate Professor **Georgeen Theodore** and her colleagues in NJIT's Infrastructure Planning Program are part of a team implementing a plan called "Living With the Bay" in Long Island. Professor Theodore's Brooklyn-based Interboro Team was one of six groups awarded federal funds for resilient design and planning in the metro NJ/NY region. With almost \$1 billion targeted to projects in New Jersey and New York, the federal initiative, Rebuild By Design, promises to help fuel the ongoing research and design critical to the region's future readiness.



HONORED BY NASA FOR HIS WORK ON VOYAGER 1

**Louis Lanzerotti**, distinguished research professor of physics at NJIT, was recently honored for his role on the team that conceived and launched Voyager 1, the first spacecraft to leave the solar system and enter interstellar space. He was recognized with one of NASA's highest awards, the Silver Achievement Medal.

Voyager 1 reached interstellar space in 2012, about 35 years after blastoff at Cape Canaveral. Its twin spacecraft, Voyager 2, is currently in the heliosheath, the outermost layer of the heliosphere. "The two Voyagers launched were designed to reach Jupiter and Saturn, with the hope that at least one might be able to go on to explore Uranus and Neptune. Voyager 2 did gather data from all four planets, and it is now also en route to crossing into the interstellar medium," says Lanzerotti.

The Voyager instrument Lanzerotti helped develop while a scientist at Bell Labs measured the density and speed of particles in the solar wind and around the outer planets. Now that Voyager 1 has reached the local interstellar medium, its instruments are making measurements of the interstellar magnetic fields, charged particles, and plasma waves unaffected by the sun and its solar wind.

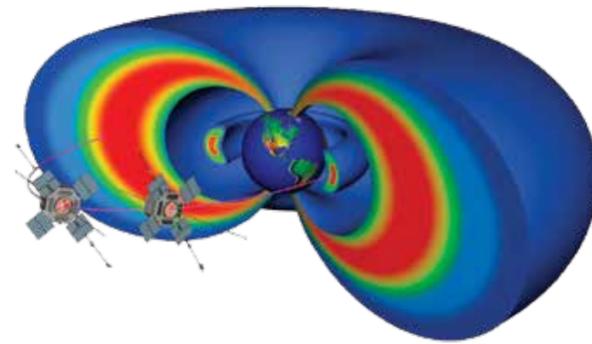
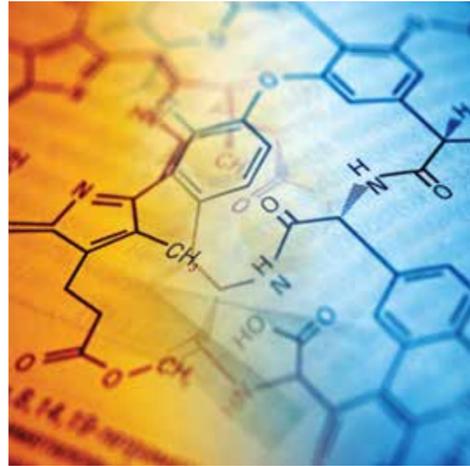


Roller coaster: Shawn Perez

Following Hurricane Sandy, NJIT's **Thomas Dallessio** and **Darius Sollohub** (left and center) met with **John Camera**, Seaside Heights Borough administrator, about recovery. Shortly after, the Center for Resilient Design was established at NJIT.

### Creating Smart Coatings

Funded by and patented jointly with the U.S. Army, a technology developed by NJIT researchers causes paints and coatings to change color when exposed to high temperatures, delivering a visual warning to people handling material or equipment with the potential to malfunction, explode or cause burns when overheated. A related technology now in development would signal damage by force, shock, or exposure to dangerous chemicals or radiation.



### Partnering With NASA

Instruments created by an NJIT-led team and now aboard NASA's Van Allen Probes have detected an invisible force field thousands of miles from Earth. This shield, just below the Van Allen radiation belts, blocks "killer electrons" emitted by the sun and prevents dangerous radiation from reaching our planet's surface.

### Keeping Drinking Water Free of Algae

Addressing issues that affect the drinking water supply, two NJIT professors have developed a promising, cost-efficient and sustainable technology using nanoparticles to rapidly remove algae from water.



### Hatching Start-Ups

New Jersey's largest and oldest business incubator, the Enterprise Development Center (EDC) at NJIT, supports technology and life-science start-ups as they develop, launch and commercialize their ideas. To date, the incubator has graduated over 85 successful businesses, and the current 95 companies in residence employ 800 people.



95

startups in NJIT's high-tech business incubator

47%

growth in research expenditures in last decade



318

patents and patents pending

1/4

of professional engineers in New Jersey hold a degree or graduate certificate from NJIT

# Research Snapshots

NJIT is ranked fourth among all U.S. universities for its productivity in turning federal research dollars into invention disclosures.



### Spurring Industry Growth

New Jersey Innovation Institute (NJII) is an NJIT corporation that applies the intellectual and technological resources of the university to challenges identified by industry partners. NJII comprises innovation labs that follow industry-led agendas. By aligning with and supporting critical industry clusters, NJII spurs product creation and enhancement, develops solutions for sectorwide and/or company-focused challenges, and serves as a catalyst for regional economic growth.



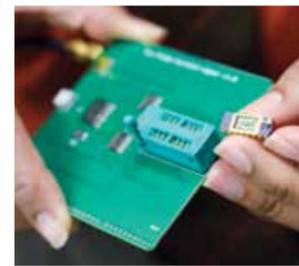
### Mining Data to Improve Health Care

Electronic medical records (EMRs) hold unprecedented potential for large-scale analytical research. An NJIT professor is using data-mining to help uncover clinical knowledge on adverse drug reactions and improve the quality, safety and effectiveness of health care.



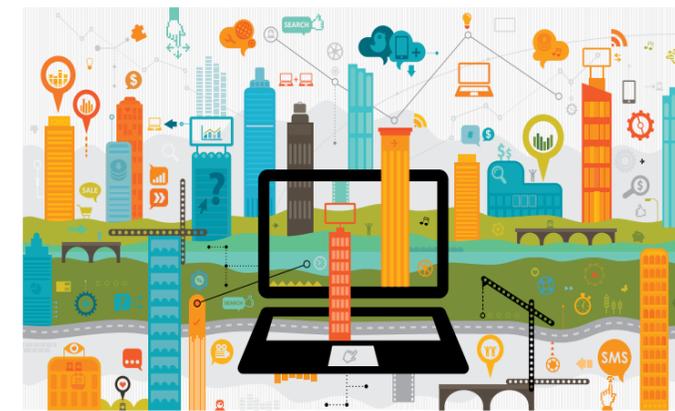
### Fighting A Mosquito-Borne Virus

An NJIT team is helping fight the spread of chikungunya, a mosquito-borne virus in the Dominican Republic. Innovative mobile technology delivers vital information about preventive care and disease management via cell phones to residents in rural regions that lack basic health services such as doctors, clinics and medications.



### Detecting Disease in a Drop

NJIT researchers have developed a prototype of a "lab-on-a-chip" that might someday enable a physician to detect disease or virus from a minute sample of blood or other fluid.



### Reducing Device-Driven Energy Consumption

The surge in power-draining electronic communication devices over the past decade has put new strains on our country's energy supply and the environment. An expert in green communications at NJIT is developing innovative mechanisms to reduce energy consumption in optical and wireless access networks.

# 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.

## **In general, how would you characterize NJIT's commitment to research, including how it compares to other peer institutions?**

NJIT already ranks fifth among all U.S. polytechnic universities for research expenditures, and we intend to build on this achievement. As set forth in *2020 Vision – A Strategic Plan for NJIT*, our goals include making scholarly research a top priority, supported by investments that will attract exceptional faculty and provide the other resources essential for multidisciplinary investigation.

This commitment is also closely aligned with the equally important integration of research and academics. Participation in the highest-quality faculty research as part of the NJIT student experience is basic to developing a workforce equipped with capabilities required in the 21st century.

## **To what extent is research integrated into the educational experience at NJIT?**

Our internationally prominent faculty teach students at all levels, and expose both undergraduate and graduate students to the results of their research. *2020 Vision* calls for integrating milestone experiences into curricular requirements for every student, with particular emphasis on undergraduate research. It also is an experience that will continue to be shared by a student body broadly representative of our society, in keeping with NJIT's commitment to foster the talents of students from diverse ethnic and economic backgrounds.

## **What areas of research at NJIT are especially promising and exciting?**

*2020 Vision* reaffirms NJIT's strategic focus on three key areas of multidisciplinary research: the nexus of life sciences and engineering, data science and information technology, and sustainable systems. Progress in these fields will result from creative interaction among people talented in many disciplines. To name just a few of these areas, our researchers will continue to collaborate in exploring traumatic brain injury, engineered particulates, regenerative medicine, transportation, computational neuroscience, wireless communication, information science, nanotechnology, cybersecurity, alternative energy, solar-terrestrial physics, resilient design, and city planning.

## **What is the balance between basic and applied research at NJIT, especially as it relates to economic development for New Jersey and the nation?**

NJIT is innovatively advancing a mix of basic, applied and translational research that promises new scientific knowledge, technological innovation and economic progress. Historically, we have focused on applied research, with emphasis on technology transfer and commercialization organized around multidisciplinary groups that benefit from partnerships among various disciplines, as well as with other educational institutions, private enterprises, and government agencies.

The recent launch of the New Jersey Innovation Institute (NJII), an NJIT corporation, has the potential to yield even more significant economic results. NJII represents a more unified paradigm for commercial innovation that draws on the coordinated resources of industry, government, and higher education.

## **What do you foresee as the future direction of research programs at NJIT?**

*2020 Vision* provides clear paths for strengthening the university's core research areas, particularly in forging multidisciplinary research connections within NJIT. However, we also acknowledge the need for closer collaboration, both locally and globally, with other institutions, industry and government. The result will be to increase both the quality and stature of research programs already under way, and to foster new initiatives.

But whatever the course of research by current faculty members and those who have yet to join the NJIT community, we are certain that there will be innovative breakthroughs in each of the strategic areas on which we are focused. We are also certain that many of these breakthroughs will contribute to a better quality of life for people in our country and around the globe, and that NJIT will be a leader in making such contributions through research for a long time to come.

**Stories of Innovation**

[njit.edu/storiesofinnovation](http://njit.edu/storiesofinnovation)

University Heights • Newark, NJ 07102-1982 • 973.596.3220

**NJIT**  
New Jersey Institute  
of Technology