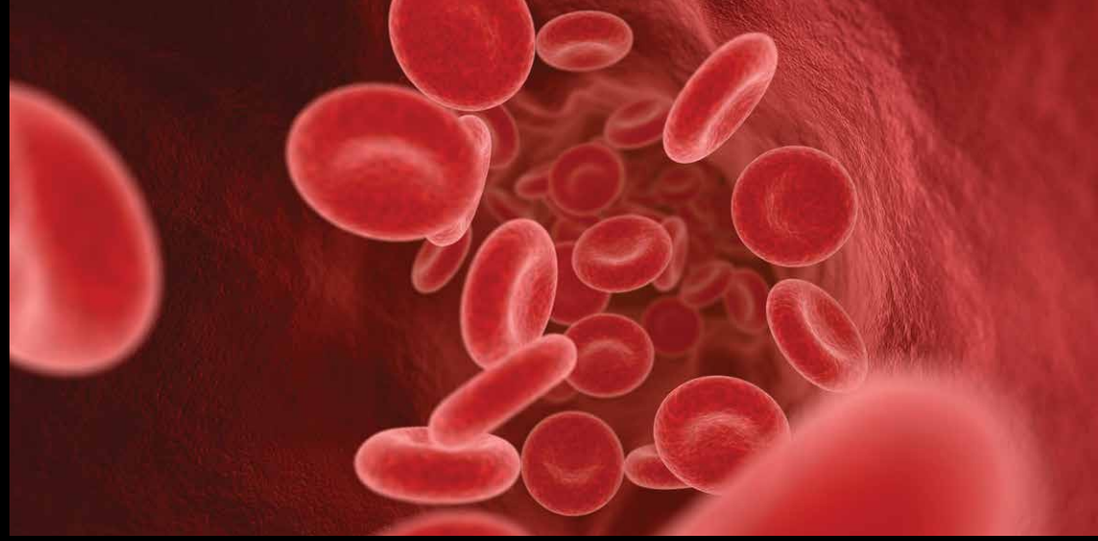
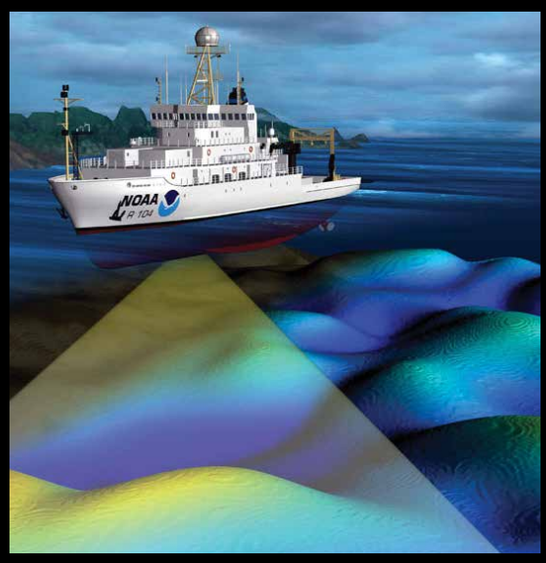
Spring 2018

NJIT
New Jersey Institute of Technology



A World-Class Technological Research University



IN THIS ISSUE

NJIT's mission is to play a leading role in four emerging areas of multidisciplinary research:

- Data Science and Information Technology
- Life Sciences and Engineering
- Sustainable Systems
- Transdisciplinary Areas (to address large systemic challenges such as smart cities)

110

new faculty hired in the past five years to serve the growing student population and accelerate research

Solving bottlenecks in traffic navigation apps

Thanks to traffic navigation apps on our smartphones, getting lost while driving is practically a thing of the past. The only problem is that these mobile apps may also be increasing traffic congestion in certain locations by directing vehicles to the same route. The cost, besides driver frustration, can run into billions of dollars annually in lost time and fuel consumption.

To counter this growing problem **Cristian Borcea** and his team at NJIT's Ying Wu College of Computing are working on a new, scalable system, one that collects real-time traffic data from vehicles and roadside sensors and then pushes individually tailored rerouting guidance to drivers when signs of congestion are observed.

Several rerouting strategies evaluated by Dr. Borcea and his team cut average travel time by half or more when applied on congested road networks. Additionally, the system greatly increased user privacy as it is less reliant on drivers sharing their starting points, current locations and destinations with a central server.

Cleaning up contaminants that threaten the environment

Fracking waste. Algae blooms. Oil spills. Industrial runoff. Acid mine drainage. These terms are all too familiar. And they signal the costly threat posed by the industrialized world to the natural environment we ultimately depend on.

It's at this juncture — where industry touches nature — that civil and environmental engineer **Lucia Rodriguez-Freire** does her research. An assistant professor in NJIT's Newark College of Engineering, Dr. Rodriguez-Freire and her team are investigating the effect of contaminants on natural ecosystems; engineering new technologies to clean up industrial and agricultural waste; and designing leading-edge wastewater treatment systems that remove persistent contaminants using readily available, inexpensive materials.

Among Dr. Rodriguez-Freire's innovations is the use of sound to break down dangerous compounds found in fire-fighting foams. She also has investigated arsenic biomineralization as a way to remediate arsenic-contaminated water, which poses a risk to the drinking water of hundreds of millions of people around the world.

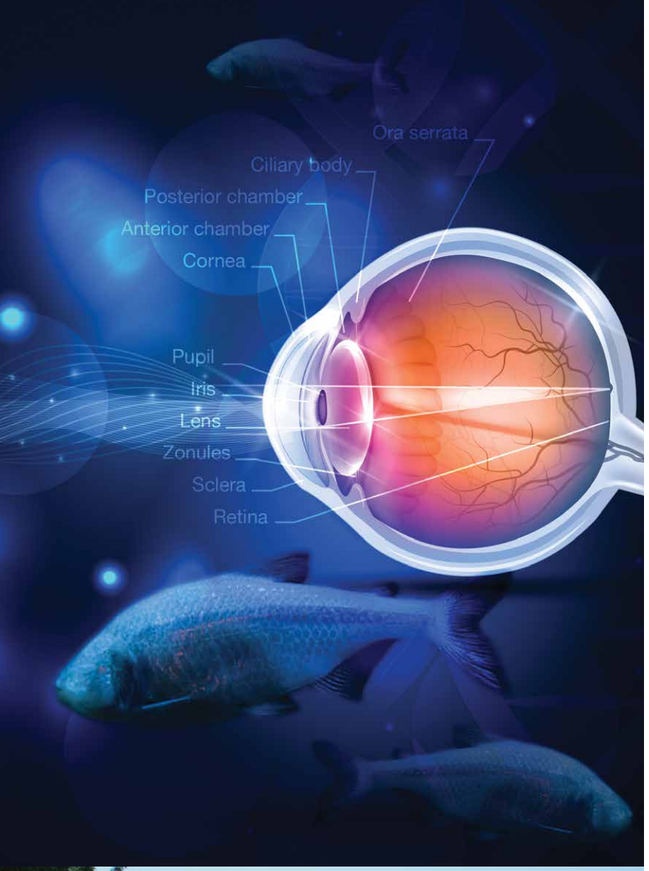


Photo courtesy of Gernot Riether

Studying blind cavefish to better treat human eyes

Born with vision, cavefish *Astyanax mexicanus* lose sight as they develop. Their lenses atrophy, their retinas degenerate, their eyes eventually disappear altogether. The cavefish, in short, is a living laboratory for the study of human eye diseases like macular degeneration.

That's why the research of biologist **Daphne Soares** and her team at NJIT's College of Science and Liberal Arts is so important. Her aim is twofold: new knowledge, plus better management and treatment of human eye diseases.

Funded by the National Institutes of Health (NIH), Dr. Soares has restored sight in cavefish larvae by transplanting a lens from a closely related surface fish. This transplanted lens does not die as the cavefish grows. The questions the research seeks to answer are basic: Will the function of the retina be restored? Will changes in the eye lead to changes in the brain?

The knowledge of neurobiology and neural plasticity gained from Dr. Soares' research and her insights into what happens when a sensory modality is restored may pave the way to faster interventions and better outcomes.

Investigating new fabrication and manufacturing methods

In his Digital Design Build Studio at NJIT's College of Architecture and Design, **Gernot Riether** and his architecture students are researching a range of topics, including new computer-controlled fabrication and manufacturing methods.

By using computational tools, rapid prototyping and digital fabrication technologies, Professor Riether's team of students is investigating how to lower costs and cut the time between design and build. They're also exploring how to use old and existing materials in completely new ways — for example, glass fiber to reinforce concrete, performance fabrics like elastane (Lycra) to build structures, and sustainable plant-based polymers for materials harder than stone.

Professor Riether and his students are also developing new approaches for training architects. As an alternative or supplement to the traditional top-down teaching model (professor to student), he challenges self-organizing, interdisciplinary student teams to act as start-up companies, integrating architects with engineers, computer specialists, fabricators and builders.

Pioneering data-hiding techniques to protect intellectual property and secure information

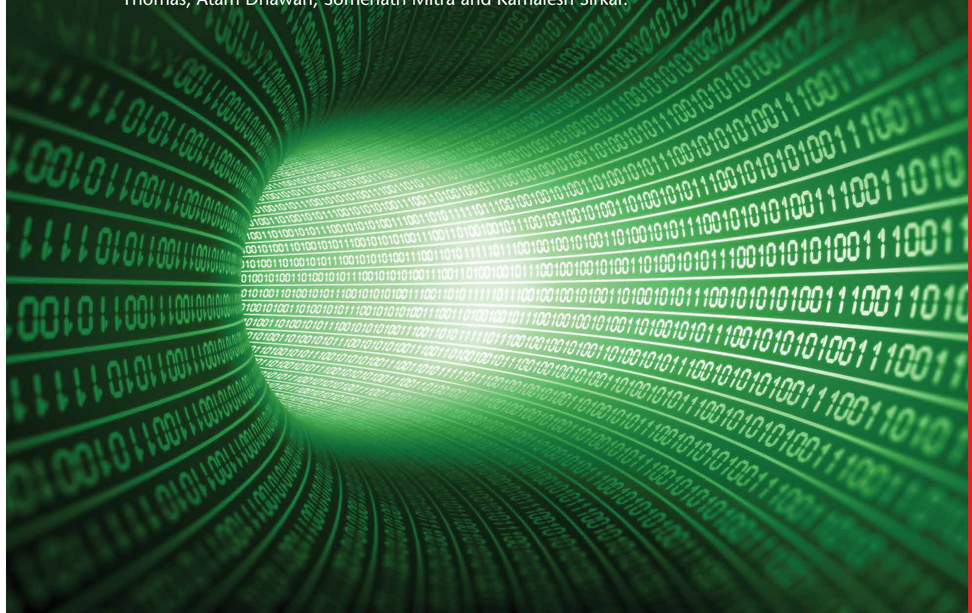
Yun-Qing Shi, a professor of electrical and computer engineering at NJIT, was named a 2017 Fellow of the National Academy of Inventors (NAI).

Dr. Shi is best known for devising methods to hide and retrieve data embedded in digitized images and speech. Data-hiding techniques are used to protect and verify intellectual property such as photos that have been digitally watermarked and can be accessed only by unlocking the encrypted information within the image, to name one widely known application. Data hiding is also used by organizations seeking to communicate secretly.

Dr. Shi holds 30 U.S. patents and has written or co-authored numerous publications, including one textbook, four chapters and more than 300 scientific papers. He was named a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) in 2005 for his contributions to multidimensional signal processing. In 2010, he received an Innovators Award from the New Jersey Inventors Hall of Fame, as well as a Thomas Alva Edison Patent Award from the Research and Development Council of New Jersey.

Election to NAI fellow status is the highest professional accolade bestowed on academic inventors who have demonstrated a prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development and the welfare of society. With the election of the 2017 class, there are now 912 NAI Fellows, representing over 250 research universities and governmental and nonprofit research institutes and collectively holding more than 32,000 issued U.S. patents.

Dr. Shi will be inducted this spring at a ceremony in Washington, D.C. He joins four other NJIT faculty members who have been named NAI Fellows in the last four years: Gordon Thomas, Atam Dhawan, Somenath Mitra and Kamalesh Sirkar.



PROFESSOR HONORED FOR PIVOTAL CONTRIBUTIONS

Louis Lanzerotti, distinguished research professor of physics, received the 2017 Arthur M. Bueche Award in October from the National Academy of Engineering (NAE) for his "extraordinary impact on the engineering profession." The annual award recognizes pivotal contributions to science and technology, as well as public policy.

The NAE cited Dr. Lanzerotti for "leadership in understanding the Earth's radiation environment and its effects on communications and space hardware, and for contributions to public policy on space-based research."

Dr. Lanzerotti began tackling some of the fundamental challenges of flying spacecraft in orbit around Earth in the mid-1960s, just as U.S. space exploration was taking off. Over the course of his career, he helped to develop robust space-based communications and science systems and contributed to NASA missions. In addition, he worked extensively on geomagnetic field measurements in Antarctica, furthering scientific knowledge of Earth's space environment. The NAE also cited his efforts to advance public understanding of space weather through papers, symposia, and participation on national and international panels.

Mitigating the Effects of Invasive Species

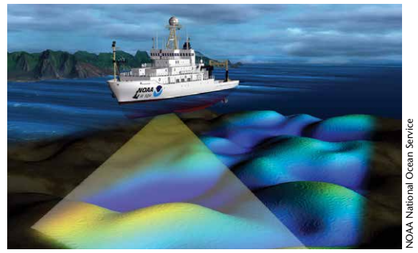
Esra Büyüktahtakin-Toy is studying ways to reduce the negative impact of invasive species — nonnative plants, animals and other organisms whose introduction can cause economic or ecological damage to an ecosystem or to human health. With a five-year CAREER grant from the National Science Foundation (NSF), she aims to create strategies to assist governmental groups, land managers, ecologists and cooperatives, among others, to better manage invasive species and formulate sound public policy. Her research approach uses mathematical modeling, optimization frameworks, game theory and uncertainty management.

Making Infrastructure Smarter

Mathew Schwartz applies the latest knowledge and technology of robotics and biomechanics to the fields of art, design and architecture. His research on smart infrastructure — planning and design strategies for the integration of autonomous vehicles like self-driving cars and drones into the built environment — may open the way for smaller personal mobility vehicles like self-driving wheelchairs that could revolutionize life for the elderly and the disabled.

Facilitating Human-Computer Collaborations

Amy Hoover develops methods for facilitating human-computer collaborations in video game design, music and sound, and art. Acknowledging that humans and computers excel in different areas of the creative process, she builds systems that harness the power and unique capabilities of each. Her research focuses on artificial intelligence systems that together with humans, collaboratively solve problems in digital and creative domains.



NOAA National Ocean Service

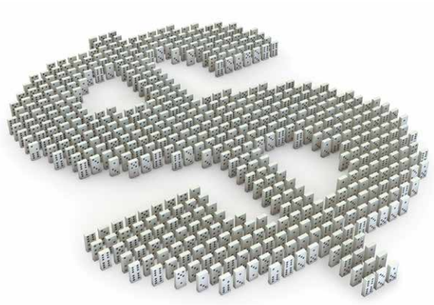
Detecting Objects Hidden Deep Under Ocean Waters

Christina Frederick is developing new mathematical and computational tools for data-driven research. Her methodology may substantially reduce computing time and costs and is applicable to a class of inverse problems — the process of reconstructing a model from data — important in scientific, commercial and defense operations. Her research, funded by the National Science Foundation (NSF), has scientific applications to sonar imaging and the detection of submerged objects or small features of the ocean floor.

Transforming Breast Cancer's Diagnosis and Treatment

Xuan Li, a specialist in optical imaging, is working to improve the diagnosis and treatment of breast cancer through a minimally invasive diagnostic technique. Supported by a grant from the National Cancer Institute, her novel method advances optical coherence tomography — a 3D, cross-sectional imaging technology with microscopic resolution — to enable a more accurate differentiation between cancerous and normal breast tissue.

Research Snapshots

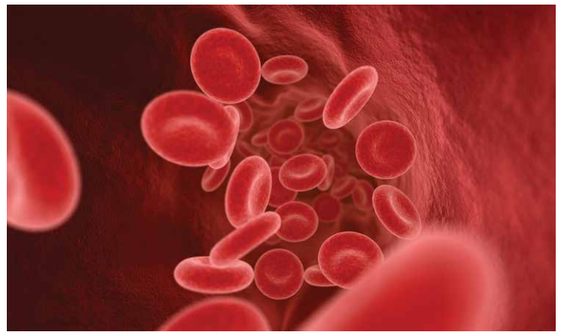


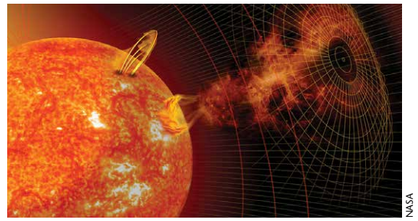
Focusing on Global Threats to Business

The **Henry J. and Erna D. Leir Research Institute for Business, Technology, and Society** at NJIT focuses on one of the most critical global challenges facing business and society today: the impact of climate change and other major disruptive events on corporate sustainability and business continuity. Through developing and applying new cognitive business and machine learning methodologies with novel business data science, visualization and analytic techniques, the Leir Research Institute will help business and industry become eco-efficient, resilient and sustainable. The Leir Research Institute under the leadership of the Martin Tuchman School of Management was established with a grant from the Leir Charitable Foundations.

Developing New Tools in the Battle Against Disease and Cancer

Sagnik Basuray, supported by a five-year CAREER grant from the National Science Foundation (NSF), is developing a new biosensor to detect and monitor infectious diseases such as HIV and certain cancers. His new electrochemical-sensing nanotechnology promises to detect, identify and quantify certain biomarker proteins at very low concentrations. The improvement in selectivity and sensitivity is expected to prevent the false negatives and false positives that often occur with current biosensors. His research also may aid in the detection of opioids in water and the development of new manufacturing techniques for therapeutic drugs.





NASA

Investigating the Acceleration of Electrons in Solar Flares

Bin Chen is exploring one of the key problems in solar physics: how electrons are accelerated within solar flares. Solar flares are the strongest explosions in the solar system, and they provide sites for particle acceleration and high-energy emissions. However, the question of how this acceleration occurs remains unanswered. His latest research project funded by the National Science Foundation (NSF) combines two powerful numerical models to simulate the physics over a wide range of scales from the large-scale flares that produce shock waves down to the smallest scales, where the particle acceleration occurs.

Strengthening NJIT's Role as a Resource for Inventors

The recent opening of the 9,500-square-foot **Makerspace at NJIT** will bring inventors and manufacturers to the campus, providing them a facility to design, build and test prototypes of their most innovative products. The state-of-the-art equipment ranges from the latest small 3D printers to large industrial machining devices, including precision measurement and laser-cutting machines. Companies can collaborate with NJIT faculty and students on research and development projects. The largest such facility serving the State of New Jersey, the Makerspace at NJIT will be a catalyst for economic growth, innovation and workforce development. The facility received $10 million in state support.

New Jersey Institute of Technology

$25 MILLION

investment from Hackensack Meridian Health in a health care ideation center on the NJIT campus

$375 MILLION

in campus construction and renovation projects are nearing completion

125+

students and more than 70 faculty mentors participate annually in NJIT's Undergraduate Summer Research Program

Dr. Somenath Mitra, a distinguished professor and executive director of the Otto H. York Center for Environmental Engineering and Science, joined NJIT in 1991. His research in the fields of environmental monitoring, water treatment and nanotechnology earned him the 2017 Benedetti Pichler Award from the American Microchemical Society. He is recognized for his work in trace measurements in waste streams and nanotechnology applications ranging from gas chromatography columns to flexible batteries, to sea water desalination.

One of the nation's leading public technological universities, New Jersey Institute of Technology (NJIT) is a top-tier research university that prepares students to become leaders in the technology-dependent economy of the 21st century. NJIT's multidisciplinary curriculum and computing-intensive approach to education provide technological proficiency, business acumen and leadership skills. With an enrollment of 11,400 graduate and undergraduate students, NJIT offers small-campus intimacy with the resources of a major public research university. NJIT is a global leader in such fields as solar research, nanotechnology, resilient design, tissue engineering and cybersecurity, in addition to others.

Q&A

Somenath Mitra

NJIT Distinguished Professor of Chemistry and Environmental Science, and Executive Director, Otto H. York Center for Environmental Engineering and Science

NJIT's current *2020 Vision* affirms a commitment to multidisciplinary research. Can you explain the importance of collaborative research at NJIT?

The clear demarcation among different disciplines is vanishing as science and technology evolve freely. In general, science has some common roots that nourish the different disciplines and the numerous types of research. In addition, the interface between science and engineering is also becoming more thematic than ever — some typical examples are the areas of energy, environment, new materials and medical devices where both science and engineering play pivotal roles. In order to remain competitive and advance research toward resolution, we need to inspire a multidisciplinary approach that embraces the depth and breadth of expertise from many different fields, making collaboration across disciplines imperative. Moreover, funding agencies and resources are expecting research alliances and partnerships.

Part of the collaboration process includes sharing equipment and facilities. How does this sharing contribute to the research process?

The instrumentation that we need to effectively conduct our research today is very expensive — high powered microscopes, spectrometers, mass spectrometers, etc. Moreover, each experiment needs multiple approaches and levels of characterizations. It is not financially feasible for each researcher to have his/her own equipment sets to carry out all these measurements. Moreover, expensive instruments need significant efforts at being housed and maintained. Therefore, shared facilities are extremely important, and typically expensive, high-powered instruments can only be afforded in collaborative space. The shared space also enhances interactions among faculty. That is also a major benefit.

In your role as executive director of the Otto H. York Center for Environmental Engineering and Science (York-LSE), can you give an example of how shared facilities contribute to the research conducted at York-LSE?

We have faculty from chemistry, chemical engineering, biomedical engineering, biology, mechanical engineering, physics, electrical engineering and others coming together to work on various research projects. Our center has many expensive instruments that are used for characterization by faculty across campus, as well as by local industry and other universities. For example, a researcher creates a material and a colleague exposes it to cells to examine how the cells grow on that material. At the next level, the material may be tested on animals. In a project like this diverse faculty from chemistry to a biomedical engineer can be involved, and that is our goal.

How would you characterize the future growth and prospects of research at NJIT as the university continues to encourage collaboration in areas such as material science and engineering, solar cells, biomaterials, and sensors and environmental systems?

Our future growth hinges upon successful collaboration across campus as well as partnerships with industry and alliances with other universities. It also depends upon the core facilities that we continue to upgrade at York-LSE. In today's research environment, it is difficult to succeed without state-of-the-art, advanced instrumentation and characterization that we plan to house at the York-LSE facility.

In your distinguished career, how has collaboration contributed to your success?

I will give an example based on my current grant from National Institute of Environmental Health Sciences (NIEHS). My collaborator is a biologist from the University of Montana, and we are studying the toxicity of nanoparticles. I create these particles with certain specifications such as length, diameter and chemical functionalities. My collaborator exposes these nanoparticles to cell cultures as well as mice to determine which forms are more toxic. Based on this we are trying to develop structure-toxicity relationships. My collaborator has limited expertise in materials chemistry, and I have limited expertise in biology. Moreover, NJIT does not have facilities to work with mice. However, together we have the expertise necessary to make this very important research a success.

Stories of Innovation
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#7 58,100 3/18 Cover photo of ship: NOAA National Ocean Service