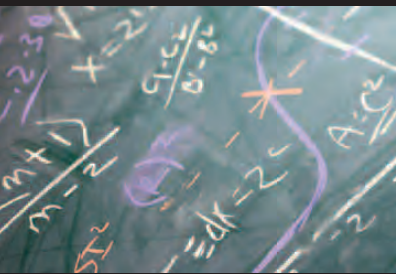


BUILDING A CORE OF NATIONALLY-PROMINENT PROGRAMS

NJIT's strategic plan proposed to build a core of programs that are recognized among the best nationally by building on strength. Mathematics, Architecture and Wireless Telecommunications were selected because these are programs that already have a level of national visibility. All three areas have demonstrated remarkable progress in recent years.



Moving Forward in Wireless Telecommunications

Enabling Technologies for Wireless Communications

Yeheskel Bar-Ness, distinguished professor of electrical and computer engineering and director of the Center for Communications and Signal Processing Research, was honored by the R&D Council of New Jersey for his contributions to technologies to

needed to support the burgeoning demand for wireless services. The group addresses issues such as privacy and security, interference and jamming, ever heavier user traffic, and rapid transmission of data through wireless networks.

user, but also by collaborating network systems.

Among the technologies under study by Bar-Ness and his team are **MIMO** (multiple input/multiple output), which uses antenna arrays to increase the bit rate of wireless communications; **OFDM** (Orthogonal Frequency Division Multiplexing), a technology that transmits multiple signals simultaneously over a single transmission path, such as a cable or wireless system; **UWB** (ultra-wide band), a radio technology that can be used at very low energy levels for short-range high-bandwidth communications by using a large portion of the radio spectrum; and **cognitive radio**, a wireless technology in which either the network or the wireless node itself changes the parameters for transmission or reception to execute its tasks efficiently without interfering with the licensed users.

During the past year, Bar-Ness has been awarded five patents in collaboration with his former PhD students.

enable the next generation of wireless digital communications. He was awarded a 2008 Thomas Alva Edison Patent Award in the University Technology Transfer category for “STBC MIMO-OFDM peak-to-average power ratio reduction by cross-antenna rotation and inversion,” a patent he received with former student **Mizhou Tan '04**.

Bar-Ness leads a team of researchers working to develop the infrastructure

Current studies focus on the concept of cooperative communications for wireless networks, such as cellular networks, sensor networks, and wireless ad hoc networks. Different from conventional point-to-point communications, cooperative communications and networking allows different systems or nodes in a wireless network to share resources to create collaboration through distributed transmission/processing, in which the signal from each user is sent not only by the

■ The award-winning patent and another, “OFDM peak-to-average power ratio reduction by combined symbol rotation and inversion with limited complexity,” with **Mizhou Tan** and **Zoran Latinovic**, provide solutions for one of the disadvantages of OFDM, a prohibitively large peak-to-average power ratio (PAPR), which results in significant in-band distortion and spectral spreading.



- “Method for phase noise suppression for OFDM based WLANs” and “Method for phase noise mitigation in MIMO-OFDM systems,” both with **Songping Wu '04**, address remedies for another OFDM problem, phase noise, which is caused by the fluctuation of the receiver and transmitter oscillator and may lead to significant performance degradation.
- “Dynamic differentiated link adaptation for ultra-wideband communication system,” with **Jordi Diaz '06**, uses an adaptive ultra-wideband impulse radio (UWB IR) transmission scheme to provide optimum usage of time diversity and significantly

higher data rates. The system is adapted dynamically for each user by varying the number of pulses transmitted per bit in response to the channel state.

Bar-Ness also received two Korean patents for his work with Samsung on fourth-generation wireless technology, which will be able to provide voice, data and streamed multimedia on an “anytime, anywhere” basis.

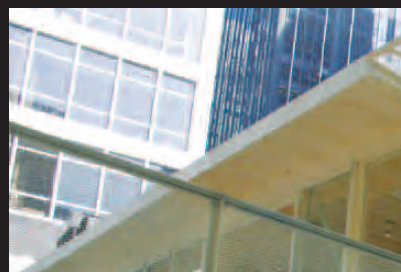
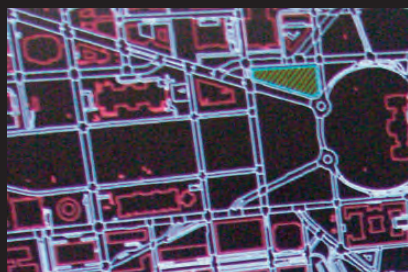
Alexander Haimovich, professor of electrical and computer engineering, is studying geolocation in collaboration with Princeton University with a grant from the U.S. Army. The study is aimed at improving the ability to localize radio



sources. The ability to geolocate radio emitters would be of value in search and rescue operations and situational awareness, as well as in the delivery of wireless 911 emergency services. The research team hopes to develop new techniques that will address the particular challenges in locating emitters in built-up, urban environments because signals are subject to multipath fading and distortion.

REDESIGNING ARCHITECTURE

New Jersey School of Architecture, already an established leader in computer-assisted architectural design, has begun a transition to a multi-disciplinary school. A BS in Industrial Design was added in 2005, and new BA programs in digital design and interior design launched in September 2008. At the same time, the school's reputation continues to grow as faculty, students and alumni gain recognition regionally and nationally.



NJSOA student **Dave Rittinger** was selected by *Surface* magazine to be featured in its annual guide to outstanding undergraduate and graduate design for his “Jersey City Bridge Museum” (*right*) designed in Assistant Professor Richard Garber’s studio.



Richard Garber (*below*), NJSOA assistant professor, won first place in a competition to design and build a visually pleasing yet utilitarian construction-site walkway at Manhattan’s MTA Fulton Street Transit Center. The largely plywood creation was conceived and prefabricated by Garber and students at NJIT’s Fab Lab. The Lower Manhattan Cultural Council and the Alliance for Downtown New York sponsored the contest. The project won an AIANY 2008 Merit Award and a 2008 NY Designs Award from the Architectural League of New York.



Three NJSOA-educated architects formed the core of a Jacobs Engineering Group, Inc. design team that won Honorable Mention in the 2008 Millennium School International Design Competition, based in the Philippines. The team, which placed fourth in the competition, included (*above, l-r*)

Brian D. B. Novello, a third-year student and intern at Jacobs’ Morristown, NJ office, **Muhammad H. Hussain ’02**, an architectural designer based in the company’s Houston office, and **Benjamin P. Bakas ’03**, an architectural designer in the Morristown office. The goal of the competition is to spur the design of disaster-resistant schools for developing countries that are prone to hurricanes, typhoons, floods, earthquakes, and other natural disasters.

NJIT’s FABLAB helped to make a special delivery to the Museum of Modern Art in New York City — one of five prefabricated homes erected in



the outdoor space next to the museum. The Burst House, conceived by architects Jeremy Edmiston and **Douglas Gauthier**, was part of an exhibit held July 20 to October 20 titled *Home Delivery: Fabricating the Modern Dwelling*, the most thorough examination to date of the historic and contemporary significance of factory-produced architecture. Gauthier, adjunct NJSOA faculty member, brought FABLAB head Assistant Professor **Richard Garber**, and NJIT architecture students into the Burst Project. FABLAB turned out about a third of the structural components for the house, cutting a total of some 200 plywood and acrylic sheets over six weeks in 12 to 15 hour shifts to meet project deadlines.





Gregory Minott '02 won Best Building Design in the Dudley Square Community Charrette and Design Competition. The Boston Society of Architects hosted the competition in association with the City of Boston, the Boston Redevelopment Authority, Common Boston and the Roxbury Masterplan Oversight Committee as part of the public programming for the American Institute of Architects' 2008 National Convention in Boston.

Designing a Formula for Success in Mathematics

The Department of Mathematical Sciences has made dramatic progress toward national prominence. The department has been ranked 10th in the nation in a study by Academic Analytics based on faculty scholarly productivity, which includes such factors as books published, journal publications, citations of journal articles, federal-grant dollars awarded, and honors and awards.



This past spring, **Daljit Ahluwalia** (right in photo above, receiving congratulations from **Dean Fadi Deek** of the College of Science and Liberal Arts), chair of the department for 22 years, was honored for his pivotal role in raising the stature of the department within the university and nationally as well as in creating an infrastructure to support NJIT's growth as a major research institution. The presentation was made at Frontiers in Applied and Computational Mathematics, an international conference established by Ahluwalia four years ago that has become a leading forum for the dissemination of mathematics research.

Under Ahluwalia's leadership, Mathematical Sciences has grown from a department offering service courses to a top-ranked program offering the BS in Applied Mathematics and Computational Sciences, the MS in Applied Mathematics and Applied Statistics, and the PhD in Mathematical Sciences. The department's current enrollment includes 114 undergraduate majors and 140 minors in math, as well as 70 students in graduate programs.

The department today has one of the most active research programs in the country among math departments, with more than \$2 million annually in external support. Faculty researchers have 25 active grants from the National Science Foundation (NSF), as well as grants

from the Office of Naval Research (ONR), the Air Force Office of Scientific Research, NASA, and private foundations and companies.

New grants this year:

- Associate Professor **John Bechtold** has NSF support to develop new mathematical theories of flames in high-pressure environments.
- Associate Professor **Roy Goodman** received an NSF grant to study nonlinear waves that arise in the modeling of systems from many areas of physics and engineering, with an emphasis on models derived from optics.
- Assistant Professor **Victor Matveev** has an NSF grant to explore the

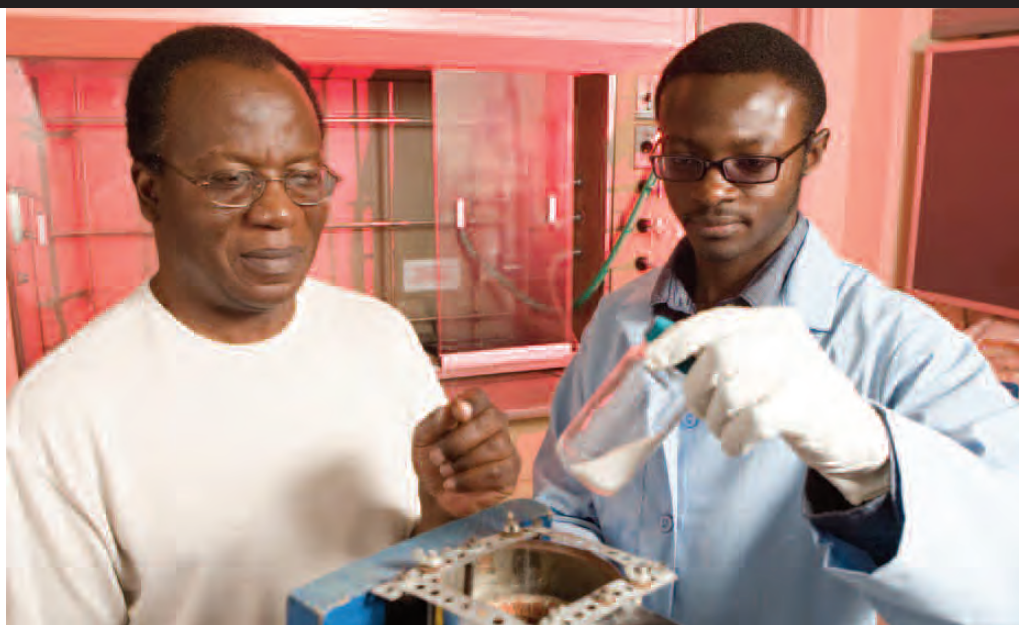
Building on Emerging Technologies

The university's strategic plan also proposed to assist economic development by strengthening three niche areas with high potential for NJIT and the State of New Jersey: nanotechnology, neural engineering, and engineered particulates. Newly-established initiatives five years ago, these areas have grown steadily. During 2007-2008, these programs continued their progress:

mechanisms of neurotransmitter release at chemical synapses, the most common form of communication between two neurons in any biological neural system.

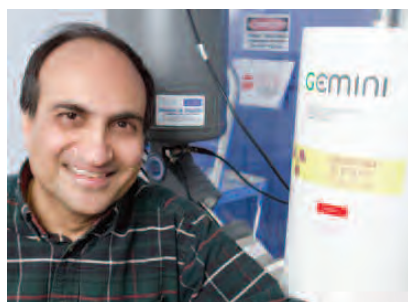
■ Associate Professor **Horacio Rotstein** received an NSF grant to study the dynamics of the experimentally observed rhythmic activity in certain areas of the brain, including the hippocampus and the entorhinal cortex.

■ Associate Professor **Wooyoung Choi** has funding from ONR to develop a comprehensive tool for predicting and monitoring the strongly nonlinear internal wave activity in the ocean.



Kwabena Narh, professor of mechanical engineering, (*above left, with student Ahmed-Tijani Agwedicham*) was awarded two NSF grants to investigate

ways to disperse carbon nanotubes in polymer matrices to create nano-composites with superior mechanical and thermal properties.



Rajesh Dave, distinguished professor of chemical engineering and director of the New Jersey Center for Engineered Particulates (*left*), is lead investigator in the NSF-supported Engineering Research Center for Structured Organic Composites, which operates in collaboration with Rutgers University,

Purdue University and the University of Puerto Rico, Mayaguez. Dave is also collaborating with **Costas Gogos**, distinguished research professor of chemical engineering in a project supported by Picatinny Arsenal's Armament Research, Development and Engineering Center (ARDEC) to develop the processes and equipment for advanced cluster energetics for military applications.

Mesut Sahin, assistant professor of biomedical engineering (*below*), works to develop technologies for interfacing with the central nervous system to learn more about its natural



function and to develop treatments for neurological disorders. With a grant from the National Institutes of Health, he is developing a spinal cord computer interface to assist patients with spinal cord injuries in gaining mobility, environmental control and computer access. In a second NIH project, he is developing floating

micro-stimulators as neural prostheses, to assist those with spinal injuries with bladder control and locomotion.

Bryan J. Pfister assistant professor of biomedical engineering (*right, top*), has been awarded a prestigious NSF Faculty Early Career Development Award to support and expand his research into rapid axon stretch growth, a technique for regenerating damaged or diseased nerve cells. He hopes to find clues to repairing traumatic injuries to the spinal cord and other nerve tissue, and to develop a nerve-tissue interface that would allow for a thought-controlled prosthesis that would behave like a natural limb.

Leonid Tsybeskov, professor of electrical and computer engineering (*below*), recently launched a new research and education laboratory equipped with a low-temperature spectroscopic system with a nanometer spatial resolution. The system supports his work with nanotechnology to increase computer-processing speed. He received two NSF grants to support his work with three-dimensional silicon-germanium nanostructures in 2007-2008, as well as support from Intel. He works in collaboration with Hewlett-



Packard Research Laboratory, the National Research Council of Canada, Motorola, Freescale Semiconductor, and Tokyo University on aspects of his research.

Richard Foulds, associate professor of biomedical engineering (*above, bottom*), directs NJIT's Rehabilitation Engineering Research Center, funded by the National Institute on Disability and Rehabilitation Research, which is developing technologies to help children with orthopedic disabilities that result from cerebral palsy, brain injuries and other conditions. He and his research team are developing therapeutic video games for disabled children.