THIRD ANNUAL
FACULTY RESEARCH SYMPOSIUM

Monday, February 23, 2015
NJIT Celebrates Interdisciplinary Research

The statistic is clearly impressive: NJIT ranks among the top five of all U.S. polytechnic universities for research expenditures. This number is also a reflection of the ongoing, significant institutional commitment we have made to leading-edge research. It is a commitment that encompasses recruiting over the past three years more than 50 exceptional faculty members dedicated to achieving interdisciplinary breakthroughs in three strategic areas – life sciences and health care, data science and information technology, and sustainable systems.

NJIT’s newest faculty, whose efforts are highlighted today, are working with the assistance of the Provost’s Office, with faculty and staff colleagues who have long experience at our university, and with students who share the excitement of scientific discovery and technological innovation as an essential part of their educational experience. It is an enterprise also made possible by support from many sources, including organizations such as the National Institutes of Health, whose program director for the Division of Discovery Science and Technology, Dr. Tiffani Lash, is our keynote speaker.

A sampling of the topics to be presented emphasizes the breadth of the work under way, and how much has been accomplished by those who have recently joined the NJIT community. It is research spanning the nanoscale investigation of new and commercially valuable materials, neuroscience, cellular physiology, cyber-security, environmental quality, wireless communications and economic development.

These are efforts are accelerated by the creative interaction of experts in biology, chemistry, mathematics, engineering, computer science and many other disciplines. The following pages provide more background about the talented individuals engaged in this work, and about their wide-ranging initiatives to improve health, develop new technologies and strategies for sustainable living as individuals and communities, and garner even greater benefits from computing and the digital transformation of daily life.

This symposium, the third since NJIT has strategically focused on interdisciplinary research, is a showcase of continuing accomplishments at NJIT in basic science and practical innovation for social and economic progress.

I thank all of those individuals whose good work has resulted in today’s symposium.

Joel S. Bloom
President of NJIT
Transforming the Research Enterprise at NJIT

Over the past four decades, NJIT has evolved from a commuter school teaching applied engineering skills into a nationally ranked public research university. This has been a remarkable transformation. In 1979, our research expenditures totaled $375,000; today they surpass $110 million. As our research profile grew, so did our capacity as an educational institution. Thirty-five years ago, NJIT granted no doctoral degrees; we have recently awarded as many as 70 Ph.D.s in 16 different disciplines during a single year. In short, the university has grown from its roots as a local college focused on teaching into a residential and highly selective research institution.

Developing knowledge and applying it to the benefit of society requires talent, substance, and resources. We are actively recruiting, developing, supporting, and retaining an exceptional faculty, providing the environment necessary for success from the moment of their appointment to the peak of our scholars’ academic careers. We also aim to break down barriers to multidisciplinary collaborations as contemporary research demands it. We value entrepreneurial research, promote our inventions, and facilitate technology transfer.

Now, NJIT is embarking on a far-reaching plan to transform our research enterprise again, elevating the university to a top tier institution conducting groundbreaking research in many fields. We aim for prominence. Nowhere are these changes more apparent than in our people. Over the past three years, NJIT has brought 50 new faculty members to campus as we deepen our capabilities across STEM and other disciplines. As part of the university’s newly adopted strategic plan, 2020 Vision, we are beginning a multi-year hiring effort that will grow our faculty even further, from 280 in 2014 to 345 by 2020. These enterprising scholars bring us not only original research and cutting-edge investigative methods from the country’s top academic institutions, but an energizing diversity that renews our traditional disciplines and broadens our research scope.

So it is with enormous pride that NJIT showcases its growing research talent in the Third Annual Faculty Research Symposium. Some of the presentations you will hear today represent interdisciplinary collaborations brought to life on campus with seed funding from a new research program designed to tackle problems in fields such as the life sciences and health care, sustainable systems, and data science that represent the university’s core strengths. They bridge disciplines as distinct as architecture and biomedical engineering. As we create new academic hubs on campus, we hope to inspire many more productive partnerships. Within the next five years, we will double funding from external sources.

We will measure the impact of our ambitious transformation from multiple perspectives. Critically, we will assess our success in materially improving lives both in our immediate region and in communities across the globe that benefit from the technology we develop and effectively deploy. Just as importantly, we will judge our achievement by the number of technology innovators we nurture in our undergraduate and graduate programs, exposing them to high-level research and real-world applications, so they are empowered to confidently take on the problems of tomorrow.

Fadi P. Deek
Provost and Senior Executive Vice President
PROGRAM

11-11:05 a.m.  Welcome
               Atam Dhawan
               Vice Provost for Research (Interim)

11:05-11:15 a.m. Welcome Remarks and Introduction to New Faculty
                   Fadi Deek
                   Provost and Senior Executive Vice President

11:15 a.m.-12:15 p.m. Faculty Research Presentations: Life Sciences and Health Care
                       Brooke Flammang
                       Assistant Professor of Biological Sciences

                       James Haorah
                       Associate Professor of Biomedical Engineering

                       Antje Ihlefeld
                       Assistant Professor of Biomedical Engineering

                       Xuan Liu
                       Assistant Professor of Electrical and Computer Engineering

                       Daphne Soares
                       Assistant Professor of Biological Sciences

                       Xiaoyang Xu
                       Assistant Professor of Chemical, Biological and Pharmaceutical Engineering

12:15-1 p.m.  Lunch

1-1:30 p.m.  Keynote Presentation
              Tiffani Lash
              Program Director
              Division of Discovery Science and Technology
              National Institutes of Health
1:30-2:30 p.m.  Faculty Research Presentations: Sustainable Systems  
Sagnik Basuray  
*Assistant Professor of Chemical, Biological and Pharmaceutical Engineering*

Shawn Chester  
*Assistant Professor of Mechanical and Industrial Engineering*

Abdallah Khreichah  
*Assistant Professor of Electrical and Computer Engineering*

Dong Kyun Ko  
*Assistant Professor of Electrical and Computer Engineering*

Hieu Pham Trung Nguyen  
*Assistant Professor of Electrical and Computer Engineering*

Wen Zhang  
*Assistant Professor of Civil and Environmental Engineering*

2.30-3:30 p.m.  Faculty Research Presentations: Data Science and Information Technology  
Elizabeth Petrick  
*Assistant Professor of History*

Kurt Rohloff  
*Associate Professor of Computer Science*

Usman Roshan  
*Associate Professor of Computer Science*

Junmin Shi  
*Assistant Professor of Management*

David Shirokoff  
*Assistant Professor of Mathematical Sciences*

Donghee Yvette Wohn  
*Assistant Professor of Information Systems*

3:30-4 p.m.  Office of Research Forum: Research Synergy and Opportunities  
Research Office Infrastructure  
Atam Dhawan  
*Vice Provost for Research (Interim)*

Collaborative Research Open Forum

4-5:30 p.m.  Poster Presentations and Networking Session

5:30-7 p.m.  Reception
Keynote Speaker

Tiffani Lash, Ph.D.
Program Director
Division of Discovery Science and Technology
National Institutes of Health

Tiffani Bailey Lash, Ph.D. serves as a Program Director and Health Scientist Administrator at the National Institutes of Health (NIH), where she manages the research portfolios for the Biosensors, Platform Technologies, and mHealth programs at the National Institute of Biomedical Imaging and Bioengineering (NIBIB). Dr. Lash is also the Program Director for the NIBIB Point-of-Care Technologies Research Network, consisting of three centers charged with developing point-of-care diagnostic technologies through collaborative efforts that merge scientific and technological capabilities with clinical need.

Prior to her current position, Dr. Lash worked within the NIH’s science policy administration. During that time, she worked at the National Institute of General Medical Sciences and National Heart Lung and Blood Institute, as well as the NIH Office of the Director. Dr. Lash has been selected as a science policy fellow for both the American Association for the Advancement of Science (AAAS) and the National Academy of Engineering. She also has a background in small business innovation and intellectual property. Dr. Lash earned her Ph.D. in Physical Chemistry from North Carolina State University via a collaboration between the Departments of Chemistry and Chemical and Biomolecular Engineering. Her interdisciplinary research interests include microfluidics, biopolymers with controlled molecular architecture, and biosensor technologies.
Faculty Research Presentations
Life Sciences And Health Care

Brooke Flammang
Assistant Professor of Biological Sciences

Title: Biomechanics of Remora Adhesion

Natural selection often favors a functional novelty if it offers a performance advantage. Remora fishes, which adhere to larger host organisms for efficient locomotion, protection, and increased food availability, evolved a complex adhesive disc apparatus from the dorsal fin spine elements typical of other fishes. Brooke Flammang, an assistant professor in biology, discovered that the adhesive disc mechanism combines suction pressure, friction, and a viscoelastic sealing mechanism to maintain a long-term grip on an actively deforming surface under high drag conditions. She is applying the biomechanics of this adhesive disc to a robotic prototype that will stick to both rough and smooth surfaces in water or air.

James Haorah
Associate Professor of Biomedical Engineering

Title: Protecting the Blood-Brain Barrier is Key to the Prevention of Neurological Disease

Disruption of the blood-brain barrier (BBB), the interface between the blood and the brain, is a hallmark of neurological diseases such as Alzheimer’s, Parkinson’s, Amyotrophic Lateral Sclerosis (Lou Gehrig’s disease), stroke, neurological disorders in drug abuse, and neuro-AIDS. James Haorah’s research objective is to protect the integrity of the BBB in order to prevent neurological diseases stemming from substance abuse, neuro-AIDS, and traumatic brain injury. He proposes that oxidative damage of the BBB enhances infiltration of unhealthy cells into the brain, which promotes neuroinflammation and interrupts the brain cells’ bioenergetic interactions. He uses human brain cells, animal models and human subjects to test the hypothesis of neurovascular alterations caused by substance abuse.

Antje Ihlefeld
Assistant Professor of Biomedical Engineering

Title: Are You Listening? How Hearing Impairment Affects the Brain

The number of hearing aid users, as well as profoundly deaf individuals whose hearing has been restored via cochlear implants, is growing steadily. While these people function well in quiet rooms, they struggle in environments with background noise. Antje Ihlefeld, assistant professor of biomedical engineering, posits that this impairment is caused not only by disorders originating in the ears, but by changes in the central nervous system (CNS), which encodes sound. These adaptations, in response to hearing loss, can further reduce a person’s hearing ability. Working with both cochlear implant users and with a biological model, she explores CNS function under hearing loss, looking closely at how the brain operates when exposed to background noise.
Xuan Liu  
Assistant Professor of Electrical and Computer Engineering  

**Title: Integrated 2PFM-OCT System for 3D Microscopic Angiographic Imaging Study of Tumor Angiogenesis**

Angiogenesis, the formation of new blood vessels, is a fundamental physiological event that plays a critical role in many physiological and pathological processes including tissue repair, tumor growth, and tumor metastasis. Imaging tumor vasculature can help researchers better understand the mechanism of cancer angiogenesis and evaluate the effectiveness of anti-angiogenic drugs. However, imaging techniques that are tumor vessel-specific, non-invasive, dynamic and high resolution are currently not available. Xuan Liu and his colleagues propose to integrate spectral domain optical coherence tomography (OCT) and two-photon fluorescence microscopy (2PFM) for co-registered intravital imaging of tumor vasculature to quantitatively evaluate vascular morphology and dynamically assess tumor metabolism status.

Daphne Soares  
Assistant Professor of Biological Sciences  

**Title: Sensory Adaptations in Extreme Environments: How Cavefish Find Their Way**

Caves and other associated subterranean habitats represent some of the most challenging environments on Earth. Despite many significant obstacles to overcome, most notably the complete darkness, several groups of animals thrive in subterranean habitats. Cavefishes, for example, have independently evolved an integrated suite of behavioral, morphological, and physiological adaptations to cope with environmental stresses and to exploit the often-limited resources in their subterranean habitats. Daphne Soares, assistant professor in biological sciences, examines how life exists in extreme environments. Insights from her research can not only help us understand the evolution of nervous systems, but also how environmental constrains favor particular outcomes.

Xiaoyang Xu  
Assistant Professor of Chemical, Biological and Pharmaceutical Engineering  

**Title: Engineering Nanomaterials and Biomaterials for Diagnostics and Therapeutics**

Nanomaterials and biomaterials with tailored physical, chemical, and biological properties have been widely used in the fields of nanomedicine, tissue engineering and regenerative medicine and provide potential solutions for many healthcare problems. Xiaoyang Xu focuses on the development of novel biomaterials and nanotechnologies for a variety of medical applications including diagnosis, bioimaging, controlled drug delivery, and regenerative medicine. We look at both fundamental and applied questions in the cross-disciplinary fields of biomaterials, nanomaterials and medicine in order to develop novel therapeutic methods for the treatment of cancer, obesity, cardiovascular disease and many others.
Sustainable Systems

Sagnik Basuray
Assistant Professor of Chemical, Biological and Pharmaceutical Engineering

Title: Bio/Micro-Nano Interface: From Diagnostic Devices to Investigating Cellular Dynamics
In collaboration with other life science researchers, the Basuray research group with its expertise in nano/microfluidics, spectroscopic techniques like SERS, Plasmonics, optofluidics, electrodynamic and electrohydrodynamic simulations from bulk to nano, is developing transformative and disruptive new technologies. The current research thrusts are: 1) developing a multidisciplinary platform for single cell analysis; 2) Micro Total-Analytical Neurological System, using Micro/Nanofluidics, Optofluidics, Impedance Spectroscopy, and Galvanotactics; 3) combining Surface Dielectrophoresis with microfluidic Lego blocks for developing a sweat sensor; and 4) an optical/electro-chemical, label-free, cost-effective and shear discrimination based on a real-time diagnostic (monitoring) device to study water contamination, heavy metal ions, and biological entities.

Shawn Chester
Assistant Professor of Mechanical and Industrial Engineering

Title: Multiphysics Mechanics of Soft Materials
Many new and exciting phenomena in mechanics are inherently multiphysical, meaning that multiple simultaneous physical phenomena are important to the mechanical behavior. Because so many technologically important phenomena are inherently multiphysics, constitutive models and associated simulation tools must also include all relevant physics to capture the primary features of the materials response and be truly predictive. In his talk, Shawn Chester will discuss recent and ongoing research on the multiphysics response of two soft material systems, specifically thermo-responsive gels and viscoelastic dielectrics.

Abdallah Khreishah
Assistant Professor of Electrical and Computer Engineering

Title: Visible-light Enhanced WiFi
Abdallah Khreishah, an assistant professor of electrical and computer engineering, is working along with his research group to utilize visible light communications (VLC) for enhancing the performance of WiFi as well as 5G cellular communication systems. VLC utilizes the unlicensed visible wireless spectrum to provide many benefits. Firstly, it provides higher bandwidth than the current radio frequency technologies (RF). Secondly, it benefits from spatial reuse to increase the capacity of wireless access systems by an order of magnitude. In addition to these benefits, with VLC we can jointly perform lighting and communication, which provides more opportunities for designing energy efficient wireless access communication. To utilize the above benefits, the research group proposes a system in which both RF and VLC can coexist and study the emerging problems of the system from the cross-layer design perspective.
Dong-Kyun Ko  
Assistant Professor of Electrical and Computer Engineering

**Title: Colloidal Nanocrystal-Enabled Advanced Energy Conversion Devices**

The need for clean and renewable electricity generation has become increasingly urgent due to climate change and energy security concerns. Traditional semiconductors come with fixed materials properties and thus lack versatility, making device optimization for high-efficiency energy conversion challenging. Dong-Kyun Ko, an assistant professor of electrical engineering, is working on developing highly tunable device building blocks, called colloidal nanocrystals, to exploit access to the nanoscale where individual steps of energy conversion take place. His research aims to tailor the matter at this scale to make radical improvements in capturing, transporting, and converting energies for advanced solar cell and thermoelectric applications.

Hieu Pham Trung Nguyen  
Assistant Professor of Electrical and Computer Engineering

**Title: III-Nitride Nanostructures for Future Solid-State Lighting and Water Purification**

Current solid-state lamps rely on the use of rare-earth doped phosphors to generate white light. Such phosphors-based light-emitting diodes (LEDs) are not efficient, have high manufacturing costs, and limited reliability. However, these critical issues can be addressed by developing phosphor-free white-LEDs through the direct generation and manipulation of light at different parts of visible spectrum. Using molecular beam epitaxy, Hieu Nguyen, an assistant professor of electrical and computer engineering, aims to develop ultrahigh-efficiency phosphor-free white LEDs. Moreover, he is focusing on epitaxial growth, characterization and applications of these nanostructures, providing ideal materials and devices for solid-state lighting, water purification, and clean energy.

Wen Zhang  
Assistant Professor of Civil and Environmental Engineering

**Title: Environmental Nanotechnology for Water Energy Nexus (WEN)**

Dr. Zhang's research integrates environmental engineering principles and nanotechnology to developing solutions for environmental sustainability and challenges in water-energy nexus (WEN). Specifically, Dr. Zhang leads a major effort in the design of innovative solar irradiation and UV-driven photocatalytic systems for efficient degradation of emerging contaminants and recovery of renewable energy (e.g., H2) from wastewater treatment processes. Moreover, novel nanomaterials are developed in his lab for antimicrobial applications, microalgae harvesting for biofuel production, and reactive membrane filtration for water treatment, with fundamental research to elucidate the mechanisms of nanoparticle-cell interactions as well as the resulting antimicrobial activity of engineered nanoparticles.
Data Science and Information Technology

Elizabeth Petrick
Assistant Professor of History

Title: Computer Technology as Empowering: From Accessible Devices to Tablet Interfaces

Elizabeth Petrick, an assistant professor of history, researches topics related to the relationship between the development of computer technology and its use, governmental policy that regulates technology and responds to social needs, and the role of computers in creating new forms of social participation. Moving forward from her book on personal computer technology for people with disabilities, Making Computers Accessible: Disability Rights and Digital Technology, she is now examining the intellectual roots of tablet computer interfaces in order to understand whether today’s tablets fulfill the original vision of a computer that would empower its user in new ways.

Kurt Rohloff
Associate Professor of Computer Science

Title: Making Cloud Computing Secure

Kurt Rohloff, an associate professor of computer science, is making cloud computing secure, enhancing privacy online and making secure information systems practical. His areas of technical expertise include practical encryption, large-scale distributed computing and scalable algorithm design. He was the principal investigator for the DARPA PROCEED program, developing practical Fully Homomorphic Encryption (FHE). FHE enables secure computing on encrypted data, but has been too inefficient to be practical until now. Dr. Rohloff’s team increased FHE efficiency by orders or magnitude and shown the first practical applications of FHE. Prior to NJIT, he worked in industry for nine years at Raytheon BBN Technologies.

Usman Roshan
Associate Professor of Computer Science

Title: Machine Learning and GPU Solutions for Problems in Comparative Genomics and Data Science

Comparative genomics and data science pose problems of considerable difficulty both in terms of accuracy and run-times. We consider two specific problems for which we have been developing new Graphics Processing Unit (GPU) and machine learning algorithms: the comparison of large genomic sequences and the prediction of cancer and disease risk from genomic data. Both have broad applications that lead to a better understanding of biology and accurate medical diagnosis. For both problems, we propose new GPU and machine learning methods that will be developed by the PI and his team of graduate students. The internal funding will cover costs for equipment (GPUs and disk-space), open-access publication, and travel to conferences and research institutions.
Junmin (Jim) Shi
Assistant Professor of Management

Title: Managing Inventories for Agricultural Products: Coffee Supply Chain

Many of the world’s poor still depend directly or indirectly on agricultural commodities for their livelihoods. Most of them are small-scale farmers in the developing countries in Africa. To achieve the millennium goal of eradicating extreme hunger and poverty in Africa, Jim Shi, an assistant professor of supply chain management, studies the coffee industry in Africa and attempts to answer two research questions about storable agricultural products under price fluctuations: How can inventory to hedge price risk be effectively managed? and How do diverse cost structures and harvest/price processes affect the results? Applying the optimal policies to practices in Kenya, it is possible to outperform the prevailing practice.

David Shirokoff
Assistant Professor of Mathematical Sciences

Title: Navigating Energy Landscapes

A wide variety of materials minimizes their associated energies by forming crystals and ordered structures. The resulting microstructures are important to predict and engineer as they often dictate larger material properties, such as strength and stiffness. Mathematically, the material’s energy can be very complicated making it difficult to predict phases of matter and material structures. David Shirokoff, an assistant professor in mathematical sciences, is working on combining computational and analytic techniques to find new, accurate methods for predicting these phases. The methods rely on first approximating the complicated material energy with a simpler energy that can then be analyzed using computation tools.

Donghee Yvette Wohn
Assistant Professor of Information Systems

Title: Soft Sustainability – Understanding Human Factors of Sustainable Systems

D. Yvette Wohn is an assistant professor in information systems whose research area is in human-computer interaction (HCI), where she studies the “soft” aspects of why people continue to interact with social systems over a long period of time, such as habits, motivations, and social capital. Understanding the social and psychological elements of sustainable technology use is especially important in the context of education and health, as these systems require prolonged engagement for effectiveness. Her current focus is developing and understanding technology to improve mental health.
**Poster Presentations**

**Keun Hyuk Ahn**  
*Associate Professor of Physics*

**Title: Nanoscale Functional Properties of Domain Walls and Vortices in Materials**
One of the themes in materials science is the discovery of new materials and states. Materials are often made of multiple domains, resulting domain walls and vortices. Even though these defects are ubiquitous in materials, scientists have just started to uncover their properties thanks to the development of high-resolution probes. Many of these defects turn out to be new states of matter, distinct from domains, and have potentials for applications. Ken Ahn, an associate professor in physics, aims to advance the knowledge on domain walls and vortices using theoretical and computational approaches, which could lead to the development of new devices.

**Xiaoning Ding**  
*Assistant Professor of Computer Science*

**Title: Memory Management for Big-Data Processing in the Cloud**
The major challenge for big-data processing is performance. Due to the huge volumes of data and irregular data access patterns, the performance of big-data applications is largely determined by how fast they access their data. For high performance, in-memory technology has become a growing trend in which data sets are completely loaded and processed in memory without accessing slow disks. Xiaoning Ding, an assistant professor of computer science and his colleagues are developing new systems to make in-memory technology more affordable and better performing in the cloud.

**Dale Gary**  
*Distinguished Professor of Physics*

**Title: Optimizing Processing Speed for Modeling Solar Microwave Emission**
The EOVSA Science Data Center (ESDC) handles the unprecedented data volume that is now being generated by NJIT’s Expanded Owens Valley Solar Array (EOVSA) radio telescope. ESDC provides the infrastructure for combining radio maps of magnetic field strength and direction in the Sun’s corona, derived from EOVSA data, with observations from other wavelengths such as mm/sub-mm, EUV, and X-rays, to model the magnetic/plasma structure in solar flares and active regions. Dale Gary, distinguished professor of physics, leads this pilot study to investigate the use of Graphics Processing Units (GPUs) for performing the required calculations fast enough to keep up with the expected demand.
Alexei Khalizov  
Assistant Professor of Chemistry and Environmental Science  

**Title: A Novel Encapsulation Approach for Chemical Analysis of Neutral Atmospheric Clusters**  
Electrically neutral molecular clusters serve as seeds for the formation of secondary aerosol nanoparticles, which represent a significant fraction of the atmospheric fine particulate matter (PM). An accurate assessment of the environmental impacts on and development of PM control policies are hindered by the lack of detailed mechanisms of cluster nucleation and growth, and require the knowledge of cluster chemical composition. Alexei Khalizov, an assistant professor of chemistry and environmental science, proposes using a combination of encapsulation and chemical ionization mass spectrometry for analysis of 1-2 nanometer neutral clusters without losing any significant information on cluster composition.

Victor Matveev  
Associate Professor of Mathematical Sciences  

**Title: CalC (“Calcium Calculator”) Software for Modeling Cell Calcium Dynamics**  
Intracellular calcium ions regulate all fundamental cell processes, from gene transcription to muscle contraction, synaptic transmission, and immune cell response. In order to simultaneously control multiple physiological mechanisms inside a cell, calcium concentration elevations have to be compartmentalized in time and space. Understanding such localized calcium signals is impossible without mathematical and computational modeling. Victor Matveev, an associate professor of applied mathematics, has created and continues to develop modeling software called CalC (Calcium Calculator) to model calcium dynamics resulting from the interplay between its diffusion and its binding by intracellular buffering molecules. Today, CalC is used to study a variety of biological phenomena, in particular synaptic neurotransmitter release.

Taro Narahara  
Assistant Professor of Digital Design  

**Title: Exploration of Unity 3D as a Physics and Animation Engine for Therapeutic Gaming and Rehabilitation Robotics**  
This project advances the state of the art in therapeutic gaming and rehabilitation robotics by seeding collaboration between the College of Architecture and Design (COAD) and the Department of Biomedical Engineering. Capitalizing on the significant NJIT expertise in computer gaming, digital design, virtual reality (VR), and robotics, the project demonstrates that gaming software (COAD) can be an effective animation and physics engine for a newly developed upper extremity exoskeleton (BME). The result will be a user-controlled haptic manipulator that allows individuals with neurological impairment (e.g. stroke, cerebral palsy) to be therapeutically assisted by the exoskeleton while haptically interacting with virtual objects in a 3-D animated environment.
Yun-Qing Shi  
Professor of Electrical and Computer Engineering  

Title: Deep Learning for Digital Image Steganalysis – Forensics to Detect Hidden Messages  
Due to their ever-growing popularity, digital images have become ideal carriers for covert communications. It is known that terrorists have had secret communications via image steganography. How to move steganalysis ahead is a critical issue our modern society faces. Yun-Qing Shi, a professor of electrical and computer engineering, proposes taking advantage of the parallel computing power of graphics processing units (GPUs) to design a deep learning based framework to radically move ahead the steganalytic capability. It is expected that the deep learning framework thus produced can also move other forensic research including image tampering detection ahead.

Roman Voronov  
Assistant Professor of Chemical, Biological and Pharmaceutical Engineering  

Title: Getting to the Roots of Disease – A Collaborative Multidisciplinary Platform for Single Cell Analysis  
Traditionally, biological experiments are performed with the assumption that all cells of a particular “type” are identical. However, recent data suggest that individual cells within a single population may differ significantly from one another, and that the amplification of these differences could be responsible for the rise of diseases such as cancer. Our interdisciplinary team of young researchers (Voronov/Biological Modeling, Basuray/Micro-Fabrication, and Xu/Drug Delivery) aims to understand the individuality of cells by obtaining experimental “fingerprints” of their behavior, and then, using the gathered data to create virtual representations of cell “identities” for long-term analysis of their behavior via computer modeling.

Songhua Xu  
Assistant Professor of Information Systems  

Title: Advancing Machine Intelligence for Information Retrieval and Knowledge Management by Exploiting Human Behavioral Clues  
The ability to quickly and comprehensively exploit data and information worldwide for evidence-based decision making is invaluable in our knowledge economy. To enhance individuals’ and organizations’ knowledge competence, a rich collection of software tools has been developed. Such tools primarily rely upon computational intelligence in their internal functioning, whose abilities are limited by the reach of today’s intelligent algorithms. Songhua Xu proposes to explore and leverage behavioral clues observed during individuals’ information access and knowledge utilization activities to advance the state-of-the-art machine intelligence for information retrieval and knowledge management via user-friendly human-computer collaboration.
Research Centers

Big Bear Solar Observatory
Dale Gary, Distinguished Professor of Physics
The Big Bear Solar Observatory (BBSO) in Big Bear Lake, California, boasts the largest aperture solar optical telescope in the world (1.6 meters). With its state-of-the-art adaptive optics and science instrumentation, the telescope obtains the highest resolution views of the Sun’s surface features, such as sunspots, filaments, faculae and granulation. Its instruments measure the magnetic fields and motions of these features to understand the basic physics of solar activity, which affect the Earth and near-Earth technological systems.

Center for Applied Mathematics and Statistics
Michael Siegel, Professor of Mathematical Sciences
The Center for Applied Mathematics and Statistics (CAMS) is an interdisciplinary research center dedicated to supporting research in the mathematical sciences at NJIT. CAMS brings researchers from academia, industry, and government to NJIT by organizing the annual “Frontiers in Applied and Computational Mathematics” meeting and other workshops. CAMS activities include support for the submission of interdisciplinary research proposals and a summer program for graduate students.

Center for Brain Imaging
Bharat Biswal, Professor of Biomedical Engineering
The Center for Brain Imaging focuses on developing and advancing techniques to understand brain processes in healthy and patient populations. We use multimodal imaging including MRI, PET, and fNIRS to study the brain. We use these techniques in a number of diseased populations including Alzheimer’s disease, Traumatic Brain Injury (TBI), stroke, and ADHD.

Center for Building Knowledge
Deane Evans, Research Professor of Architecture
The Center for Building Knowledge (CBK) is a 25-year-old research, training and technical assistance institute affiliated with the College of Architecture and Design at NJIT. CBK is dedicated to generating new knowledge to improve the built environment and enhance the planning, design, construction and operation of facilities. Led by Executive Director Deane Evans, CBK’s mission is to help individuals and communities make better-informed decisions concerning the performance, sustainability and resilience of buildings nationwide.
Center for Injury Biomechanics
_Namas Chandra, Professor of Biomedical Engineering_

The Center for Injury Biomechanics, Materials and Medicine (CIBM3) is a multi- and inter-disciplinary research center focused on understanding, diagnosing and treating brain injuries and concussions using experimental and computational methods. Namas Chandra, Bryan Pfister and James Haorah, along with colleagues from NJIT, medical schools and veterans administration facilities take a holistic approach to offer new measurement techniques, diagnostics/prognostic tools to address sports injury and military medicine.

Center for Manufacturing Systems
_Wayne Chaneski, Executive Director_

The Center for Manufacturing Systems (CMS) is an advanced technology center with a dual mission of offering manufacturing expertise to small and mid-size companies and providing machining and fabrication support for university research programs. The Center is staffed with professionals who have spent many years in industry. This experience, combined with state-of-the-art manufacturing equipment, enables the Center to transform concepts into reality.

Center for Membrane Technologies
_Kamalesh Sirkar, Distinguished Professor of Chemical, Biological and Pharmaceutical Engineering_

The Membrane Science, Engineering and Technology (MAST) Center, a NSF I/UCRC, and the Center for Membrane Technologies investigate problems where membrane technologies can achieve separation and purification of water, air, industrial fluid streams, solvents, pharmaceuticals, proteins, biopharmaceuticals, cells, particles and nanoparticles.

Center for Natural Resources Development and Protection
_Michel Boufadel, Professor of Civil and Environmental Engineering_

The Center for Natural Resources Development and Protection investigates sensible approaches to environmental and energy resource utilization. Directed by Dr. Michel Boufadel, research projects at the NRDP Center include assessment and remediation studies of pollution in natural settings, and the evaluation of natural resources for the potential production of energy, especially the production of renewable energy.

Center for Resilient Design
_Thomas Dallessio, Director_

Through applied research, field testing and community outreach, the Center for Resilient Design provides residents, business owners, design professionals, non-profit leaders, government officials and researchers with actionable 21st-century ready-to-build designs and expertise for disaster recovery in areas that have experienced or anticipate natural or man-made disasters.
Center for Solar-Terrestrial Research  
*Andrew Gerrard, Professor of Physics*

The Center for Solar-Terrestrial Research (CSTR) at New Jersey Institute of Technology (NJIT) is an international leader in ground- and space-based solar and terrestrial physics, with interest in understanding the effects of the Sun on the geospace environment. CSTR operates the Big Bear Solar Observatory (BBSO) and Owens Valley Solar Array (OVSA) in California, the Jeffer Observatory at Jenny Jump State Forest in New Jersey, and the Automated Geophysical Observatories (AGOs) distributed across the Antarctic iceshelf. The Center also manages a large number of instruments at South Pole Station, McMurdo Station, across South America, and across the United States. CSTR is also a PI organization in the NASA Van Allen Probes mission and houses the Space Weather Research Laboratory, which does scientific research in the area of space weather with the mission to understand and forecast the magnetic activity of the Sun and its potential influence on Earth. Such instrumentation and data resources enable scientific studies spanning from the Sun’s surface, into the Sun’s extended atmosphere, and onwards into the Earth’s atmosphere.

In this presentation, we will review CSTR assets and a survey of future capabilities. New resources coming online within CSTR in the next year include new instrumentation at BBSO (e.g., the 10830-He spectropolarimeter), OVSA (e.g., status of the OVSA Expansion effort), and at the AGOs (e.g., higher power availability and data telemetry). Our plans to site a solar radio telescope at South Pole Station, as well as the lidar observatory in New Jersey, will also be noted. In addition, we discuss the pending challenges of “Big Data” that the CSTR is now facing, and how this looming issue impacts both our own group and broader users.

Center for Transportation  
*Lazar Spasovic, Professor of Civil and Environmental Engineering*

The Center for Transportation conducts interdisciplinary research, education, and technology transfer designed to improve safety and mobility of the nation’s transportation system. Research projects include development of intelligent transportation systems technologies, transportation network modeling and management, traffic simulation, transportation, land use and economic policy analysis, freight planning, and traffic data warehousing.

Center for Wireless Communications and Signal Processing Research  
*Alexander Haimovich, Distinguished Professor of Electrical and Computer Engineering*

The Elisha Yegal Bar-Ness Center for Wireless Communications and Signal Processing Research (CWCSPR) engages in a broad range of research ranging from wireless communications, radar, sensor networks, cloud radio, information theory, and signal processing. A unifying theme of the Center’s research is that of 5G wireless mobile networks. The Center seeks new collaborations with the wireless communications industry.
Enterprise Development Center
Jerry Creighton, Sr., Executive Director
The Enterprise Development Center (EDC) at NJIT is a business development and commercialization center with an ecosystem designed to advance high-tech and life-science entrepreneurial initiatives. The array of service programs available at the EDC combine the student, faculty and NJIT resources with a “know-how” network of subject matter experts, partnerships, resident company interactions, university/business/government collaborations as needed to assist resident companies with R&D tasks, meeting milestones, scaling their business and preparing to obtain access to capital.

Expanded Owens Valley Solar Array Science Data Center
Dale Gary, Distinguished Professor of Physics
The EOVSA Science Data Center handles the unprecedented data volume that is now being generated by NJIT’s Expanded Owens Valley Solar Array (EOVSA) radio telescope. ESDC will provide the infrastructure for combining radio maps of magnetic field strength and direction in the Sun's corona, derived from EOVSA data, with observations from other wavelengths such as mm/sub-mm, EUV, and X-rays, to model the magnetic/plasma structure in solar flares and active regions. Dale Gary, distinguished professor of physics, leads this pilot study to investigate the use of Graphics Processing Units (GPUs) for performing the required calculations fast enough to keep up with the expected demand.

Leir Center for Financial Bubble Research
William Rapp, Henry J. Leir Professor of International Trade and Business
The Leir Center for Financial Bubble Research seeks to understand through quantitative and qualitative research how financial bubbles can be identified including their stages of development, their relation to financial crises and what policies can best manage their adverse impacts.

Nanotechnology and Opto-electronics at the Electronic Imaging Center
Haim Grebel, Distinguished Professor of Electrical and Computer Engineering
The Electronic Imaging Center at NJIT promotes unique structures (nano- and sub-wavelength structures) for effective interfaces between photons (light) and matter for the purpose of: multi-spectral imaging in the visible, infrared (IR) far-IR and microwave with better sensing and light filtration; nano-based elements to aid detection of pollutants and viruses (e.g., swine and avian flu) for portable molecular biology instruments; nano-optical antennas for accurate molecular detection; ultra-short pulse (USP) antennas for secured communication links and environmental monitoring; and unique electronically controlled ion devices (the ion transistor).
New Jersey Center for Engineered Particulates

Rajesh Dave, Distinguished Professor of Chemical, Biological and Pharmaceutical Engineering

The creation of advanced particulate materials through the engineering of particles is a major research focus of the New Jersey Center for Engineered Particulates (NJCEP). The Center is engaged in fundamental research that combines experimental, computational and theoretical studies to achieve an understanding of the particle properties at the individual particle scale, in order to predict powder behavior at the macro-scale. As the size of particles becomes smaller and smaller, down to the nano-scale, the particle properties at the particle scale can change drastically and significantly affect the bulk properties, sometimes resulting in unique added value to the particulate materials. These value-added particles are called engineered particulates, which is the central focus of NJCEP.

NJ-HITEC

William O’Byrne, Executive Director

As part of the NJII Healthcare Delivery Systems iLab, NJ-HITEC was formed in 2010 as New Jersey’s regional exchange to support health information technology use by New Jersey providers. NJ-HITEC has the most successful Regional Extension Centers, established by the Office of the National Coordinator for Health Information Technology, in the country and is considered by New Jersey doctors to be their “trusted health IT advisor.”

New Jersey Homeland Security Technology Systems Center

William Marshall, Director

The Homeland Security Technology Systems Center (NJHSTSC) at NJIT was created by Executive Order 111 expressly to work in collaboration with state government, serving as consultant for technology evaluation against performance standards and engaging in prototype deployment of integrated systems for testing, demonstration and training. It has contributed to all areas of the Homeland Security mission throughout the state.

New Jersey Innovation Institute

Timothy Franklin, Vice President

The New Jersey Innovation Institute (NJII) is an NJIT corporation that applies the intellectual and technological resources of the state’s science and technology university to challenges identified by industry partners. NJII is comprised of innovation labs that follow industry-led agendas, these include: Healthcare Delivery Systems; Bio-Pharmaceutical Production; Civil Infrastructure; Defense and Homeland Security; and Financial Services.
Neural Interface Laboratory
*Mesut Sahin, Professor of Biomedical Engineering*

The Neural Interface Laboratory focuses on the field of neural prosthetics within a broader area of neural engineering. The long-term objective is to develop devices implantable in the central nervous system that can improve functioning for disabled individuals with spinal cord injury, traumatic brain injury, ALS, or stroke.

Neuromuscular Engineering Laboratory
*Richard Foulds, Associate Professor of Biomedical Engineering*

Researchers study the blending of neural motor control and muscular activity, promoting improvement of ambulation, reaching and manipulation, and speech, as well as explore the modulation of incorrect neural signals producing spasticity and dystonia; the development of upper and lower extremity exoskeletons; and physiologically sound human-robot interaction.

Structural Analysis of Biomedical Ontologies Center
*Yehoshua Perl and James Geller, Professors of Computer Science*

The Structural Analysis of Biomedical Ontologies Center (SABOC) is devoted to research exploring structural issues in medical terminologies and ontologies such as the Unified Medical Language System (UMLS), SNOMED CT, and the biomedical ontologies located in the NCBO BioPortal. We are working on summarizing, visualizing and auditing medical terminologies.

Tissue Engineering and Applied Biomaterials Laboratory
*Treena Arinzeh, Professor of Biomedical Engineering*

The laboratory develops novel tissue engineering approaches to treating damaged tissues in orthopaedic and neural applications. The laboratory primarily uses functional biomaterials to stimulate cells to regenerate tissues and evaluates these therapies using in vitro and in vivo models.
Vision and Neural Engineering Laboratory
Tara Alvarez, Professor of Biomedical Engineering
Convergence insufficiency (CI) is a prevalent binocular vision disorder that negatively impacts the activities of daily living. Symptoms include double/blurred vision, eyestrain, and headaches during reading or other near work that negatively impacts activities of daily living. CI is present in 4 percent of the population where approximately 27 percent of CI patients do not improve even with validated therapy. This project studies two potential mechanisms causing CI which may be improved via validated therapy by quantifying phoria adaptation, neural substrates and behavioral eye movements. This knowledge can lead to targeted therapeutic interventions, improved success rates, reduction in the time to remediation, and reduced healthcare costs.

York Center for Environmental Engineering
Somnath Mitra, Distinguished Professor of Chemistry and Environmental Science
The Otto York Center is the home of core laboratory facilities at NJIT. It serves the university and the industrial community by offering facilities for material characterization, chemical analysis, and environmental measurements.