NJIT New Jersey's Science & Technology University

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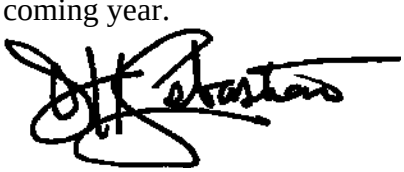
A Message from the Interim Provost & Sr. Vice President for Research and Development

Students are the lifeblood of the university and your role as student researchers is critical to fulfilling our mission. We are proud of your individual and collective contributions. I am so pleased that the Dana Knox Student Research Showcase gives NJIT an opportunity to put a spotlight on your accomplishments. This is the first year in which the event is designated in memory of Professor Knox, and I am very happy to see that we have a record turnout of student presenters honoring his years of service as a scholar, mentor and university leader. Thank you all for putting your best efforts into making this event a fitting tribute to that record.

NJIT has a unique distinction among the thirty-one public universities in New Jersey. It is one of only three public universities in the state that are authorized to offer Ph.D. degree programs, and the only one concentrated on scientific, engineering and professional education – we are truly "New Jersey's University of Science and Technology". Our growth in research over the last twenty five years is dramatic. Research expenditures now account for over one third of NJIT's budget. We anticipate a new record high for research expenditures in 2009, exceeding $90 million for the first time ever. This places NJIT in the top ten among universities whose programs are predominantly science and engineering.

NJIT's research expertise has made it the "go-to" school when civic leaders need help in understanding complex technological issues that confront public policy, like environmental impacts of manufacturing, renewable energy and sustainable design, child-safe handgun mandates, physical infrastructure and port security, transportation planning and most recently, stem cell research and electronic voting. Our efforts to revitalizes the local economy by attracting and growing technology-based businesses will transform University Heights in the coming years. All of these capabilities tie back to the work conducted by our students, faculty and technical professional staff giving us competency, credibility and objectivity that is respected throughout the state.

Congratulations on your achievements and best wishes for your future studies or career endeavors in the coming year.



Donald H. Sebastian, Ph.D.
Provost (Interim) & Sr. Vice President for Research & Development

The Dana Knox Student Research Showcase

"A Glimpse into the Future"

featuring
Outstanding Research by NJIT Students

Wednesday
April 8, 2009

Campus Center Atrium

1:00	Welcome
1:00-3:00	Research Poster Presentations by NJIT Students and Judging of Posters
3:15 – 3:30	Awards Ceremony

Karina Aliaga (partner with Joseph Hanna), Junior in Mathematical Science, "Does the PY Neuron Exhibit Resonance?" (advisor Amit Bose)

The property that describes the neuron's preferred response to inputs of injected current is called resonance. To produce resonance, a cell must possess a low-pass filter (attenuates high frequencies) and a high-pass filter (attenuates low frequencies). All neurons automatically possess low-pass filtering properties. Using a combination of experiments and mathematical modeling, we set out to determine whether the PY neuron of the STNS (stomatogastric nervous system) of Cancer borealis exhibits resonance. We showed that although the PY neuron has an Ih (hyperpolarizing activating current) channel that acts as a high-pass filter, it does not exhibit resonance. We next used the dynamic clamp technique to increase the conductance of the Ih current and demonstrated that under this condition, resonance exists. To model these results we used the Hodgkin-Huxley equation and showed that under low conductance, resonance was not evident, but when conductance increased, the PY neuron had frequency preference. This led us to conclude that while the PY neuron has an Ih current; its conductance is too low to produce resonance. The probable cause for this is that PY cells are small in size relative to the other STG cells, resulting in less Ih channels per unit membrane.

Ankur Agrawal, PhD Student in Civil & Environmental Engineering, "Impact of Climate Change on Coastal Water Quality - A Remote Sensing Approach", (advisor Sima Bagheri and A. Agrawal)

Ocean color data acquired by current satellites - SeaWIFS and MODIS with the synoptic coverage can give information about the oceans/coastal zones which play an important role in the exchange of carbon dioxide between ocean and atmosphere. Increases in phytoplankton composition and abundance due to global climate change can contribute to important changes in water quality conditions. This is considered to be a major pathway of carbon cycling in the ocean and thus essential to global change studies. Since phytoplankton depends upon specific conditions for growth, they frequently become the first indicator of a change in their environment. Phytoplankton, as revealed by ocean color, frequently show scientists where ocean currents provide nutrients for plant growth and where subtle changes in the climate-warmer or colder more saline or less saline-affect phytoplankton growth. With increasingly sophisticated sensors, better data and improved algorithms, water quality parameters - phytoplankton can be accurately determined using ocean color data.

The intent is to test the utility of multisensor/multitemporal data in visualization and future integration with biooptical/statistical methods to enhance our understanding of ecosystem responses and estimation of water quality conditions to manage eutrophication. The long term goal is to ultimately link global scale processes with local environmental and resource problems to assess the impacts of climate change on freshwater/estuarine systems in NY/NJ metropolitan areas.

Amrita Banerjee, PhD Student in Electrical & Computer Engineering, "Graphenated IR Screens" (advisor Haim Grebel)

Graphene an atomic thick two dimensional crystal was deposited on infrared screen. These substrates were used to enhance weak infrared and Raman signals.

Ashish D. Borgaonkar, PhD Student in Environmental Engineering, "Characterization of Natural Organic Matter and Trihalomethanes Formation Potential in Drinking Water by Spectral Fluorescence Signatures", (advisor Taha Marhaba)

The characterization of dissolved organic matter (DOM) in source water is not only central to the study of precursors to disinfection byproducts (DBPs), but can also aid in controlling the discharge of potentially harmful organic chemicals into a water bodies. Rapid determination of six DOM fraction concentrations provides an added advantage in understanding the organic character of water than the measure of dissolved organic carbon (DOC), which is an aggregate parameter typically used by water purveyors. The experimental procedure for DOM isolation and fractionation by ionic resins is lengthy and tedious. Many attempts have been made towards development of faster and reliable techniques. Fluorescence is a very sensitive technique and works best only at certain wavelengths that are different for different materials. It is therefore difficult to quantify a material using fluorescence technique, especially when the entire fluorescence matrix is considered. To address this difficulty, a two stage processing technique is developed in this research in an attempt to build an enhanced model using principal component regression (PCR). At stage I, this new technique reduces the dimensionality of the input data by focusing on specific portion of the entire matrix that contains the peak locations for all the parameters considered. Then statistical analysis follows as stage II. In addition, the same technique is applied to predict Trihalomethanes Formation Potential (THMFP). This model provides better sensitivity and accuracy, while maintaining the earlier model's advantages of rapid identification and quantification of DOM fractions.

Michael Brown, PhD Student in Urban Systems, "Lessons in Revitalizing Distressed Public Housing: HOPE VI in Camden, New Jersey", (advisor Karen Franck)

Using three HOPE VI grants received in 1994, 2000 and 2006, Camden Housing Authority has been modernizing its three largest and worst housing developments for more than a decade now. The goal is to transform living conditions at the three sites by rehabilitating their physical landscapes, deconcentrating poverty, and promoting self-sufficiency among residents through educational, employment, counseling family, and other support services. Strategies used to achieve these goals include diversifying the mix of housing solutions offered to include homeownership and differential options, admitting households with a wider range of incomes, relocating some residents to other developments, dispersing some resident to private housing in better neighborhoods using vouchers, and evicting "problem tenants."

HOPE VI is government's most comprehensive effort to address longstanding problems in the nation's public housing program. Implemented in 1992 upon the recommendations of a congressional committee, HOPE VI awarded 562 grants worth $6.2 billion to rehabilitate 282 distressed properties by the end of 2005. Two of the three properties in Camden were demolished and replaced with newly constructed housing and support services, based on New Urbanist planning methods, and the third was redesigned and rehabilitated.Using census data, and data from interviews done with residents, and HOPE VI officials, this study examined how HOPE VI impacts the lives of residents in terms of poverty deconcentration, physical improvements, and residents' self-sufficiency. The overarching question the study asks is: How has HOPE VI impacted the lives of residents of McGuire Gardens, Westfield Acres, and Roosevelt Manor public housing developments?

Michael Cabal, Junior in Mechanical Engineering, "EHD Filter Development of the Flow Rate", (advisor Boris Kusid)

Differential scanning calorimetry or DSC is a thermoanalytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference are measured as a function of temperature. The main application of DSC is in studying phase transitions, such as melting, glass transitions, or exothermic decompositions. Determining the properties of the drug and the polyethylene glycol was essential in order to create the solid dispersion.

Mingzheng Cao, PhD Student in Electrical & Computer Engineering, "I/Q Imbalance Mitigation for Time-Reversal STBC Systems Over Frequency-Selective Fading Channels", (advisor Hongya Ge)

Space-time block coded (STBC) communication systems provide reliable data transmission by exploiting spatial diversity in flat fading channels. To further exploit the multi-path diversity embedded in the frequency-selective fading channels, time-reversal (TR) STBC system have been proposed and studied extensively. In practical implementation, the in-phase/quadrature (I/Q) imbalance (the non-ideal matching between the relative amplitudes and phases of I and Q branches of a transceiver) exists in many RF systems due to analogue imperfections. This commonly results in a small complex conjugate term in time domain, hence an equivalent mirror-image distortion term in frequency domain in the data structure of communication systems. Therefore, I/Q imbalance increases symbol error rate (SER) drastically, especially in STBC systems utilizing both symbols and their complex-conjugates. In this work, we develop a new transmission scheme that enables simple yet effective solutions, both in time domain and in frequency domain, to mitigate transceiver I/Q imbalance for TR-OSTBC systems operating over frequency-selective fading channels. The proposed method can mitigate the transceiver I/Q imbalance at the receiver with only the estimated effective channel state information (ECSI). It combines the tasks of estimating the transmitter I/Q imbalance parameters, the channel and receiver I/Q imbalance. Simulation results demonstrate that the transceiver I/Q imbalance can be effectively compensated by employing the proposed solutions with either known or estimated ECSI.

Nick Carlson, PhD Student in Civil & Environmental Engineering, "Protective Jackets to Blunt Blasts on Buildings and Bridges: Proof of Concept and Parameter Study", (advisor Ala Saadeghvaziri)

A promising, innovative water-based protective mitigation system design has been proposed; its design concept is based on the concept of energy dissipation through damage, flow and phase-change of the protective, sacrificial layers in order to mitigate the damaging effects of explosive shock waves on structural members such as columns and bridge piers. Initial qualitative and quantitative testing of the concept demonstrates that early prototypes of this system were able to reduce the amount of energy transmitted by an impact load to the material underneath. As part of the initial proof-of-concept research, a series of prototypes of these protective jackets have been created and mounted on a structural steel beam instrumented with strain gages and an accelerometer to measure its deflection and vertical movement over time; the jacketed beams are then subjected to a dynamic impact load to study the response of the jackets under rapid loading and to measure the change in dynamic response and deformation of the beam. Numerical analysis of the strain shows a reduction in both the deformation of the member and of the energy transmitted into the beam by the impact event. Future testing in cooperation with Picatinny Arsenal will involve the use of shock testing using explosives to further simulate real-world blast conditions.

Daniel Carrera-Guzman, Junior in Mechanical Engineering, "EHD Filter Development: The Effect of Temperature", (advisor Boris Khusid)

Previous work has been done to design an electro- hydrodynamic (EHD) filter to remove soot particles from fresh oil. This new working model has been designed but requires efficiency tests to ensure success under different temperatures and other parameters. Through the use of dielectrophoresis, the filter is able to capture micro-particles as contaminated oil runs through the filter. The aim of this study was to select the optimum parameters with which the diesel-lube oil could be filtered under different especially conditions of temperature, and current. The final result will be the expansion operating regimes; and improve the single pass efficiency.

Matt Causley, PhD Student in Mathematical Sciences, "Stability and Phase Error Analysis of the Cole-Cole Dielectric Model, (advisor Peter Petropoulos)

We present an analysis of the numerical stability and accuracy for a numerical scheme to solve a fractional hyperbolic PDE system which finds application in the computation of electromagnetic pulses propagating in dispersive dielectrics whose permittivity is represented in the frequency-domain by the Cole-Cole model $\epsilon(\omega) = \epsilon_\infty + \frac{\epsilon_s - \epsilon_\infty}{(1+(i\omega\tau)^\alpha}, \ \alpha \in (0,1).$. Validation of our analysis using numerical solutions will also be presented.

Yuhong Chen, PhD Student in Chemistry, "Carbon nanotube-zirconium dioxide hybrid for defluoridation of water", (advisor Som Mitra)

This study presents the synthesis of zirconia/multi-walled carbon nanotube (ZrO2/MWCNTs) hybrid as a novel sorbent for water defluoridation. The synthesis was facilitated by the high degree of functionalization of MWCNTs using a microwave assisted process. In the final product, nearly 3 % of the carbon atoms were attached to ZrO2. The ZrO2/MWCNTs were significantly more effective in fluoride removal than all other sorbents tested here, including ZrO2 impregnated carbons. The research findings highlight the potential application for the use of metal-MWCNT hybrids in environmental remediation.

Hyung Won Choi, PhD Student in Computer Science, "DRIVE - Dispatching Requests Indirectly through Virtual Environment", (advisor Andrew Sohn)

Dispatching a large number of dynamically changing requests directly to a small number of servers exposes disparity between the requests and the machines. In this paper, we present a novel approach that dispatches requests to servers through virtual machines, called Dispatching Requests Indirectly through Virtual Environment (DRIVE). Client requests are first dispatched to virtual machines, which are subsequently dispatched to actual physical machines. This buffering of requests helps reduce the complexity involved in dispatching a large number of requests to a small number of machines. To demonstrate the effectiveness of the DRIVE framework, we set up an experimental environment consisting of a PC cluster and four benchmark suites. With the experimental results, we demonstrate that use of virtual machines indeed abstracts away the client requests and hence helps improve the overall performance of a dynamically changing computing environment.

Shabnam Darjani, PhD Student in Civil Engineering, "Performance and Serviceability of High Performance Steel Bridges", (advisor Ala Saadeghvaziri)

There have been significant advances in development of high performance materials over the past two decades. High Performance Steel (HPS) is an example that provides up to 18% cost savings and up to 28% weight savings when compared with traditional steel bridge design materials. HPS offers higher

yield strength, enhanced weldability, and improved toughness, which results in smaller cross sections, lighter and much more economical designs. On the other hand, smaller cross section leads to more flexible bridges that do not satisfy the existing serviceability deflection criteria.

AASHTO Standard Specifications limit live load service deflection to L/800 for general bridges and to L/1000 for bridges that are used by pedestrians. These limits were employed to avoid "undesirable structural and psychological effects due to their deformations." However, results of prior studies indicate that deflection and L/D limits do not necessarily address these objectives. Existing limits do not prevent damages in structures because they check global deflection, while the damages are a consequence of local deformations such as connection rotations and twisting of floor-beams relative to support members. Furthermore, human susceptibility is more influenced by derivatives of deflection rather than the deflection itself. Thus, there is a need for development of a more rational serviceability criterion which is the objective of this study.

This poster presents the preliminary results of an analytical study to develop more rational serviceability and durability criteria. The analytical study employs 2-D and 3-D Finite Element (FE) models to evaluate dynamic response of bridges under moving truck load. Results are compared to special exact cases where solutions exist. The results are in agreement with exact solution. Parameter Study is being performed. Among parameters considered are truck speed, number of spans, damping ratio, number of trucks, and spatial effects. The poster also presents a brief literature review and provides comparison of AASHTO deflection requirements to other available countries specifications such as Canada and Europe.

Srinivasamurthy Devayajanam (partner with Arun Ramadass), PhD Student in Physics, "Magnetic Augmented Rotational System – Application to Wind Mills", (advisor Nuggehalli Ravindra)

Traditionally, windmills have been designed to operate at a set range of wind speeds since wind is variable and site specific. This lowers the overall efficiency of the wind mill and makes operating costs high. The proposed setup utilizes a magnetically augmented rotation system for improving drive wheel and prime mover (i.e, wind power in this case) efficiency by operating at various wind speeds. Wind power is considered to be a promising and encouraging alternative for power generation because of its tremendous environmental and social benefits.

Richa Dhawan (partner with Princy Pathickal), Junior in Biology, "Telomere Damage Induced Senescence in Organs of Aging Primates", (advisor Karen Roach)

Cellular senescence is the irreversible growth arrest that occurs in all human somatic cells and functions as a potent tumor suppressor mechanism. As senescent cells buildup, they may potentially contribute to the biological aging of organisms through the depletion of organ systems required to maintain homeostasis. A question raised is if telomere induced senescence contributes to tumor suppression and organismal aging in aging baboon tissues and if cellular senescence affects multiple organ systems. Dysfunctional telomeres that have lost their protective function ultimately lead to senescence. It has been demonstrated in the lab that senescent cells containing telomere damage accumulate in aging baboons. As a result, the objective of the study is to determine whether the buildup of these senescent cells in aging animals is a factor leading to the functional decline of organs such as the heart and lungs that is observed in old age. The ultimate objective of the study focuses on the potential to impede the development of aging-related diseases such as diabetes through the manipulation of the senescence program in certain tissues without compromising the protection gained by cellular senescence.

David Diaz, Senior in Biomedical Engineering, "Computerized Burn Diagram", (advisor Michael Bergen)

Doctors treat over 500,000 burns a year in the US, and of those approximately 40,000 of those burn victims need to be admitted to the hospital. The most important element in burn care is speed of administering care. The faster the skin can be cooled down, the better the chances of reducing the damage. In order to increase the speed of treatment, we are designing a computer program that will replace normal paper burn diagrams. The program will automatically calculate the percentage of Body Surface Area (BSA) burned of the patient as the doctors shade the area burned in a tablet pc interface. Several graphic design programs and programming languages have been analyzed and studied to best fit the solution of this problem. Out of all of the choices, two were chosen as potential solutions to this problem. A prototype is being created using the AutoCAD software.

Josehp DiNapoli (partner with Robert Pietrocola), Senior in Architecture, "Newark Bus Rapid Transit", (advisor Darius Sollohub)

The Newark Bus Rapid Transit study results in a transit network that overlays the existing transit system present in Newark. Through community outreach and analysis of the existing system and research to investigate the urban fabric of Newark, we are able to develop a detailed transit network that becomes a catalyst for future transit oriented sites in Newark. In addition to BRT's inherent economy, efficiency and speed of deployment, there are other advantages to deploying it in Newark. Primary among these is that the City's urban pattern evolved around the streetcar network of the last century and that BRT can be readily deployed on these existing streets with minimal disruption. The second advantage is that Newark's residents already use buses extensively. In other cities in the US, where BRT is planned, ridership is often a trickle. In these places, patrons need to be coaxed from their cars and extraordinary measures are taken to package BRT to remove many of the negative connotations that many associate with buses. In Newark, improving service will be its own advertisement. Third, deployment has political and fiscal advantages at every level of government. As a mechanism of smart growth planning, BRT will likely receive endorsement if not support from State agencies. At the federal level, BRT is far more likely to be funded over lightrail in the New Starts Program. Finally, while it might be a minor coincidence, BRT as it is built worldwide was actually first conceptualized in Newark in the 1950's by PSEG and General Motors to replace the streetcar network that was highly interconnected into other regional infrastructure at Penn Station and other nodes. BRT could restore this functionality as well as restore the City's spirit of innovation.

Ezinwa Elele, PhD Student in Chemical, Biological & Pharmaceutical Engineering, "Electrodeless electro-hydrodynamic printing of personalized drug dosage", (advisor Boris Khusid)

The variation in drug efficacy in individuals has imposed a limitation on current pharmaceutical technologies which have evolved around processes for large-scale production and designed for large populations. These processes are unable to meet the needs of tailored therapeutics designed to work for a small number of patients. The sequencing of the human genome is yielding new tools for personalized medicine. Under a personalized medicine scheme, drug prescribing and dosing will be carefully tailored to a patient's individual genetic background. Although promising, the application of current drop-on-demand (DOD) systems to the delivery of patient-specific drugs poses a number of challenges since a pharmaceutical product must be protected from chemical changes over the drop formation and deposition cycle. The proposed field-induced DOD method eliminates adverse electrochemical reactions at the fluid/electrode interface and enhances high precision drop printing and dosage control. The fluid infused into an electrically insulating nozzle serves as a floating electrode capacitively coupled to external electrodes in order to generate an electric force exerted on a pendant drop formed at the nozzle exit. A short pulse alternating current voltage applied to external electrodes stretches the pendant drop into a liquid bridge which breaks up creating a sessile drop on

an edible substrate which could be post-processed into a film dosage form. This method can be used for printing fluids of different physical properties in pharmaceutical, biomedical, and biotechnology applications.

Amir Fakhrzadeh, Junior in Biology, "Brain Maturation in Children with Autism Spectrum Disorders", (advisor Dennis Carmody, Institute for the Study of Child Development, UMDNJ)

At birth brain maturation is nowhere near complete. The brain starts out in infancy as a mushy compilation of scattered neurons. As we mature, connections in our brain are made by these neurons that extend to each other in a process known as myelination. The study relates brain maturation to behavior and deals mainly with two groups, infants and older children (pre-adolescents). While typically developing children develop a sense of self-recognition in contrast, children with Autism Spectrum Disorders have delays in these events. Four main areas of the brain are the focal points of the research. In connection with Autism, there is lack of a sense of self-recognition in these children. Without this sense of self, children with Autism Spectrum Disorders appear rather inattentive and removed from our everyday world. These are the four brain regions most involved in self-related events: the temporal poles, temporo-parietal junction, occipital lobe, and the medial frontal cortex. Each of which will be examined closely by analyzing and quantifying MRI images of children's brains. What is being measured is the percentage maturation in these specific areas of the brain. We can accomplish this by comparing white and gray matter in those regions using a program created at UMDNJ made specifically to quantify the divergence in white and gray matter in the brain. Another step will be to compare the left and right side of the brain in these cases to see whether any trends form in terms of the symmetry of connectivity.

Xiaoni Fang, PhD Student in Mathematical Sciences, "Signal propagation through static and dynamic dense granular systems", (advisor Lou Kondic)

This paper presents a study of signal propagation through dense granular systems. A two-dimensional model for soft spherical particles is used. Well-defned propagating signals are observed from both static and sheared systems, depending on volume fraction of the system, polydispersity of the particles and properties of the perturbation. We find that monodispersive system lacks well-defined propagation signal, possibly due to particle crystallization. A decrease of volume fraction also leads to loss of well-defined propagation. We will discuss the influence of varying the properties of the perturbation on the signal propagation. This study is currently ongoing.

Catherine S. Florio, PhD Student in Mechanical & Industrial Engineering, "Computational Simulation of the Growth of a Femur Bone", (advisor Albert Narh)

The relationship between the structure of bone and its loading environment was first observed in the 1600's. Since then, researchers have formulated quantitative mathematical descriptions and computational predictions of the structural changes of bones due to various loads. One application of particular interest is the study of femoral bone development. Examining how loading behavior, such as walking, affects the overall shape of the femur can improve the understanding of early hominid locomotion and the effectiveness of modern physical therapy techniques. In this study, a computational simulation of the growth of a femur was performed based on a similar study using the Carter-Wong endochondral ossification model. A custom user-defined material model that included this bone growth model was written, validated, and applied to a simplified 3D representation of a child's femur using commercial finite element software. A constant growth, due to normal biological factors, was uniformly applied to the bone, and a variable growth, related to the local octahedral shear and hydrostatic stresses resulting from an applied load, was also added. The total bone growth was simulated through the addition of a "growth strain" that allowed the geometry to change shape without

actually adding material. Modifications to the original model were made in the current work for computational stability and physiological accuracy. Four distinct loading cases were studied over a simulated six-month growth period. The structural changes and stress distributions in the femur resulting from this simulation compared favorably to similar simulations published by previous researchers and to reported clinical measurements.

Shanmugamurthy Fnu, PhD Student in Physics, "Directed Self-Assembly of Carbon Nanotubes For Devices", (advisor Reginald Farrow)

There has been a great deal of research and development interest in using single wall carbon nanotubes (SWNT) as device elements for a host of applications. This poster focuses on a novel method to fabricate individual or controlled arrays of interconnected vertically oriented SWNTs using electrophoresis with applications as transistors and single/multiple element biomolecular detectors.

Wycliffe A. Graham, PhD Student in Material Science and Engineering, "Synthesis, X-ray Structures and Magnetic Properties of the First Fluorophthalocyanine Sandwich Complexes", (advisor Sergiu Gorum)

Bis phthalocyanine (Pc) lanthanide complexes may exhibit single-molecule magnetic properties as thin-films. Their ability to function in harsh environments, however, is limited by the presence of C-H bonds. Molecules which do not contain C-H bonds are unknown. A microwave assisted method was used to synthesize the first representatives of this new class, bis[octakis(perfluoro *i*-C_3F_7)(perfluoro)phthalocyninato]Ln(III), formulated as $(Pc^{2-})(Pc^{-\bullet})$Ln(III), Ln = Tb, Dy. Single-crystals allowed the elucidation of their structure at atomic level via X-ray diffraction while UV-Vis, mass (MS), infra-red (IR) and Nuclear Magnetic Resonance (NMR) confirmed their solution identity and electronic configurations. Thermogravimetric analysis (TGA) revealed their high thermal stability while variable-temperature magnetic measurements of the crystals with a Super Conducting Quantum Interference Device (SQUID) revealed molecular paramagnetism and a non-zero Weiss temperature. A strong magnetic coupling between the lanthanide 4*f* electrons and the single radical anion $F_{64}Pc^{\bullet-}$ confirmed the proposed formula. Exploration of thin-film formation is in progress.

Sukeshini A. Grandhi, PhD Student in Information Systems, "Title: Interruption Response Management in Mobile technology", (advisor Quentin Jones)

Mobile communication technology such as cell phones increases our ability to communicate but also creates the problem of increased number of interruptions. People currently handle such interruptions in different ways. One common practice is to not allow interruptions to come through by turning off the communication technology. However this comes with the price of missing out on interruptions that may be important or desired based on one's social and work responsibilities. The other common practice is to allow the interruption to come through (such as an incoming call) and making a conscious, deliberate decision to ignore or engage in it. The effectiveness of this practice however depends on how accurately one estimates the costs and benefits of responding to the interruption which in turn depends on knowing what the interruption is about and under what circumstances is the interrupter intruding. This issue is of particular relevance to mobile communication technologies such as cell phones where the only information currently available to the receiver is the Caller ID.

This research explores how we can aid people in making informed interruption response decisions by providing information in addition to who the interrupter is. We addressed this research question through three empirical studies of people's cell phone use which confirmed the importance of this additional information in call handling decisions. We also explored the ease and utility of providing this information (such as caller's context, call reason and call importance/urgency) by building and testing a lightweight interruption management tool for cell phones.

Anjani Gunturu (partner with Suarwee Snitsiriwat), PhD Student in Environmental Science, "Polycyclic Aromatic Hydrocarbons (PAHs) in intertidal sediments on the bay shoreline Sandy Hook, New Jersey", (advisor Nancy Jackson/Joe Bozzelli)

Polycyclic aromatic hydrocarbons (PAHs) are a significant class of organic pollutants related to fossil fuels having both anthropogenic and natural sources. They are present in fuels like coal, crude oil and gasoline; but the anthropogenic sources are more important as the PAHs are emitted to the environment as emissions from the combustion of fossil fuels, accidental oil spills, waste incineration and incomplete combustion with soot formation. The presence of PAHs in the environment is of growing concern due to their carcinogenic and mutagenic properties and their bio-accumulation in animal tissue, resulting from high partition coefficients. These persistent organic pollutants are hydrophobic in nature which effect bottom dwelling organisms forming an important connection between the sediments of the intertidal zone and the local food web, thus accurately reflecting pathways for PAH uptake[1].Most studies of PAHs in Raritan Bay have focused on the subtidal environment of the estuary. The purpose of this research is to determine the cross shore and alongshore presence and concentration of PAHs in intertidal sediments (to a depth of 0.20 m) at Spermaceti Cove, Horse Shoe Cove and Ferry Dock on Sandy Hook spit. These sites were chosen because previous investigations have documented PAH concentrations in subtidal sediments[2] and a national sediment toxicity survey identifies these areas of Sandy Hook as an area of high sediment toxicity (USEPA 1997). These studies were performed and the three sites were observed to have significant levels of accumulation of these toxic PAH's like naphthalene, anthracene, phenanthrene etc. This study involves wet sieving followed by microwave digestion, SPME and GC-FID analysis of the sediment samples. GC analysis of these samples showed significant concentrations of certain PAH's like phenanthrene and anthracene.

Nirupama Gupta, PhD Student in Environmental Science, "Directed evolution of Laccase: Controlling substrate specificity", (advisor Edgardo Farinas)

The spore coat laccase, CotA, from *Bacillus subtilis* was converted from a "generalist", an enzyme with broad specificity, to a "specialist", an enzyme with narrowed specificity. Wild-type CotA oxidizes ABTS (diammonium 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonate) and SGZ (4-hydroxy-3,5- dimethoxy-benzaldehyde azine). It was engineered for increased specificity for ABTS by combining rational and directed evolution approaches. The wild-type was evolved by simultaneously randomizing 19 amino acids found in the substrate-binding pocket. A mutant was identified that had a catalytic efficiency, $(k_{cat}/K_M)_{ATBS}$ / $(k_{cat}/K_M)_{SGZ}$, 7 times greater when compared to the wild-type. This illustrates that laccases can be efficiently engineered using active site saturation mutagenesis.

Sathishkumar Gurupatham, PhD Student in Mechanical Engineering, "Sudden Spreading of Particles Sprinkled Onto a Liquid Surface", (advisor Phushpendra Singh)

We experimentally study the dependence of the velocity with which particles sprinkled onto a liquid surface move away from each other on the factors such as the radius and density of particles, the liquid viscosity and the interfacial tension. The velocity is maximal a short time after particles come in contact with the liquid surface, and subsequently it decays with time. Furthermore, after their initial momentum decays to zero, particles reverse direction because of the attractive lateral capillary forces which ultimately cause them to cluster. The velocity during the latter attractive phase is relatively smaller.

Paula Gutierrez, Senior in Biology, "Cocaine Induced Brain Changes: Linking Human Effects as Observed Through Rat Model, (advisor Karen Roach)

Cocaine abuse is a severe problem in our society. Its addictive qualities have made it increasingly prevalent without discriminating sex, race or socioeconomic status. The study presented aims at revealing the association between cocaine dependence and changes in brain anatomy. The anatomical alterations observed, indicate cognitive impairments that influence treatment retention and eventual recovery. There is human data that suggests white brain matter changes in early abstinence are linked to continued treatment, which leads to eventual recovery. The changes observed are increased fractional anisotropy (FA) in the inferior frontal white matter and corpus callosum two-six weeks after terminating drug use. Fractional anisotropy refers to a measure found in diffusion tensor imaging (DTI), which is a neural tract measure derived from magnetic resonance imaging (MRI). The main direction of the diffusion tensor can be utilized to conclude the white brain matter connectivity of the brain to see what part of the brain is connected to the other. The changes observed are linked to treatment drop out but are reversible with longer periods of abstinence. This study uses rats treated with seven days of daily cocaine inoculations, suggests brain changes observed in humans are replicated with the rats. Rats that were studied 30 days after the last cocaine injection showed significantly higher FA in similar regions observed in human cocaine users compared with cocaine-treated rats studied one day after the last injection.

David Hamoui (partner with Catherine Morrison), Senior in Mathematical Science, "Predicting Plant Succession", (advisor Amit Bose)

Plant community succession is the at least somewhat predictable sequence of species compositions that follows a landscape disturbance (for example, clear-cutting). We assisted with the planning process for a proposed experiment to test whether this successional process is amenable to manipulation. First, we tested the magnitude of the influence of two kinds of stochasticity on the prediction of community composition from estimated Markov models of the successional process. The first kind of stochasticity comes from the probabilistic nature of the Markov process, although this is only a factor if individual plant species transitions are modeled (rather than proportions of species in an infinitely large population). The second kind of stochasticity comes from uncertainty about the true underlying Markov model, which can be incorporated if separate estimated transition matrices are available from different experimental plots, for example by the use of an interval, or "set" matrix. We drew conclusions about the appropriate number of plots relative to their size. Second, we examined the relationship between the history length of a successional process available to estimate its transition matrix, and the accuracy of predictions of community composition immediately following the estimation interval. We show how this relationship will differ for homogenous and non-homogenous Markov processes, and present some real-world examples.

Joseph Hanna (partner with Karina Aliaga), Junior in Biological Science, "Does the PY Neuron Exhibit Resonance?" (advisor Amit Bose)

The property that describes the neuron's preferred response to inputs of injected current is called resonance. To produce resonance, a cell must possess a low-pass filter (attenuates high frequencies) and a high-pass filter (attenuates low frequencies). All neurons automatically possess low-pass filtering properties. Using a combination of experiments and mathematical modeling, we set out to determine whether the PY neuron of the STNS (stomatogastric nervous system) of Cancer borealis exhibits resonance. We showed that although the PY neuron has an Ih (hyperpolarizing activating current) channel that acts as a high-pass filter, it does not exhibit resonance. We next used the dynamic clamp technique

to increase the conductance of the Ih current and demonstrated that under this condition, resonance exists. To model these results we used the Hodgkin-Huxley equation and showed that under low conductance, resonance was not evident, but when conductance increased, the PY neuron had frequency preference. This led us to conclude that while the PY neuron has an Ih current; its conductance is too low to produce resonance. The probable cause for this is that PY cells are small in size relative to the other STG cells, resulting in less Ih channels per unit membrane.

Xinxian Huang, PhD Student in Mathematical Sciences, "The Activity Phase of Neurons in a Reciprocally Inhibitory Network", (advisor Amitabha Bose)

In a network of two reciprocally inhibitory neurons, the firing time of one neuron has an effect on the period of the other one, and vice versa. We investigate the phase of activity of neuron A as a function of the relative firing time of neuron B. We examine the conditions for the existence and stability of phase-locked activity. We determine the phase of activity of the mutually inhibitory network from information about two different feed-forward inhibitory networks. One characterizes the dependence of the cycle period of A on the relative firing time of B, and the other determines the relation between the phase of B and the period of A. In the special case that the period of A is linear function of the relative firing time of B, we obtain conditions on the existence and stability of phase-locked solution and describe the circumstances under which the solution is unique.

Laila Jallo, PhD Student in Chemical Engineering, "Cohesiveness characterization of functionalized powders at the bulk and Particle level", (advisor Raj Dave)

Cohesiveness of surface modified powders is characterized at the bulk and particle level. The correlation between bulk and particle level measurements is achieved by adhesion force modeling based on the particle level properties and plastic contact deformation.

Amin Jamali, PhD Student in Civil & Environmental Engineering, "Controlled Composite Action to Eliminate Deck Cracking: Preliminary Results", (advisor Ala Saadeghvaziri)

A significant number of concrete bridge decks develop transverse cracking which can accelerate corrosion of reinforcing steel, deteriorate deck concrete and possibly cause damage to underneath components of the bridge and its esthetic. Shrinkage and thermal contraction of restraint concrete are main causes of such cracking which mostly develop at early ages. There have been many studies on the cause of transverse deck cracking which mostly were focused on concrete mix design and construction practices. There have been also a limited number of studies on effect of structural design factors on concrete bridge deck cracking. However, the problem still exists as concrete changes volume and restraining effect of the girder causes development of cracks.

The restraining effect is basically due to the composite design of the superstructure. Thus, shrinkage cracking can be prevented if a mechanism can be developed to prevent this composite action during early ages (i.e., as concrete shrinks), while it is activated for higher service load and under ultimate loading condition. To achieve this objective the shear connectors can be wrapped in a hyper-elastic material of carefully designed thickness. Under low level of stresses the material does not provide any resistance and it deforms easily and the concrete deck can shrink without any restraint. Upon development of shrinkage strains the hyper-elastic material will start to develop higher level of resistance and will ultimately provide full composite action. Proper design will require development of a realistic relationship between the shrinkage strain and the wrap thickness. Design of these

materials, i.e., their thickness, modulus of elasticity, etc. should be performed very carefully to achieve the required controlled composite action (CCA).

Bernard Jones (partner with Paul Ray), Master in Emergency Management, "Critical Infrastructure and Key Resource (CIKR) Interdependencies", (advisor Mike Chumer)

Our research team will conduct a qualitative research study to develop a Critical Infrastructure Key Resource (CIKR) baseline interdependency report for the nine U.S. states that make up the All Hazards Consortium (AHC). Those states include: NJ, NY, PA, DE, MD, VA, WVA, NC, DC.

The report will identify existing multi-state planning organizations, existing multi-state tasks, and other efforts.

The report will also then become integrated into an AHC portal which will allow for the storage and cataloging of these resources segmented within the various areas that are collaborating for inter-state Critical Infrastructure Protection (CIP) coordination of efforts.

In summary, the many deliverables of this research study will make future regional incident response efforts much more efficient as well as move our region to becoming more resilient in the face of disasters.

Ruttika Joshi, Senior in Mathematical Science, "Interest Rate Swaps", (advisor Karen Rappaport)

The history of financial instruments began only about half a century ago with the trading of financial derivatives in stock exchanges. Interest rate swaps came even later; some where around 1981; when the World Bank and IBM Corporation traded interest rates to meet their specific needs while abiding by the borrowing limits that the global economies had set for themselves. Interest rate swap is a financial derivative in which the two parties involved in a swap exchange cash flows of interest payable on a certain principal amount. The whole point of exchanging cash flows is maximizing profit and minimizing the risk associated with floating interest rates attached to loans. Although the ultimate aim of interest rate swaps is similar to that of commodity swaps, both these financial derivatives function differently. This poster shall explain the mathematics behind interest rate swaps, how they work with a cash flow at hand and how they differ when a dealer steps in. Further, the research attempts to come up with a solution for just the right amount of interest rate that a corporation may swap to minimize risk and maximize profit.

Yogesh Joshi, PhD Student in Applied Mathematics, "Discrete Dynamical Population Models: Higher Dimensional Pioneer-Climax Models", (advisor Denis L. Blackmore)

There are many population models in the literature for both continuous and discrete systems. We begin with a general discrete model that subsumes almost all of the discrete population models currently in use. Some results related to the existence of fixed points are proved. We then concentrate mainly on a 3-dimensional Pioneer-Climax model. Most of the previous studies of such models have been for 1-dimensional or 2-dimensional systems only. An extensive theoretical and computational investigation of the dynamics of discrete 3-dimension Pioneer-Climax models is conducted, including an analysis of fixed and periodic points, bifurcations and chaotic regimes.

Manmeet Kaur, PhD Student in Applied Mathematics, "Acoustic and Fluid Forces on Perturbed Spherical Objects", (advisor Denis Blackmore)

In this study, the time averaged acoustic radiation force and drag on a small, solid nearly spherical object moving in a slightly incompressible, low viscosity fluid subject to a stationary sound wave is

approximately calculated. This problem has been solved for a spherical object in several foundational papers, and it has many important engineering applications related to segregation and separation processes for particles in fluids such as water. Small but significant errors have been observed in the predicted behavior of the particles using the existing (classical) approximate perfect sphere solutions. The main goal of this research is to extend the classical approach to objects that deviate slightly from a spherical shape and to estimate the corresponding contributions to the acoustic and drag forces.

Mahesh Khanolkar, PhD Student in Mechanical & Industrial Engineering, "Shape Memory Polymers: Modeling and Mechanics", (advisor Joga Rao)

Shape Memory Polymers (SMP) belong to a large family of active or smart materials which are defined by their capacity to store a deformed (temporary) shape and recover an original (parent) shape. They have the ability to change size and shape in response to changes in temperature, moisture, light, pH, or electric and magnetic fields. SMP materials are predominantly used in deployable space structures, medical devices, Biological Microelectro Mechanical Systems (Bio MEMS) and scores of other applications.

Since the inception of shape memory polymers as smart, active materials most of the research been done is experimental. Relatively little work has addressed the constitutive modeling of the unique thermomechanical coupling in SMP. Constitutive models are critical for predicting the deformation and recovery of SMP under a range of different constraints. Rao et al 2006 have developed a model for the thermo mechanics and phase change occurring in crystallizable shape memory polymers (CSMP). The model developed was for large deformations and is based on the theory of evolving natural configurations. The aim of this research is to formulate a constitutive model for glassy shape memory polymers (GSMP), which takes into account the fact that the stress-strain response depends on thermal expansion of polymers. The model captures the amorphous rubbery phase, the cooling process, the shape fixity and melting to return to its original shape. The effect of nanoreinforcement on the response of glassy shape memory polymers (GSMP) is studied and a model is developed. In addition to thermally responsive shape memory polymers we are currently investigating on modeling the mechanics of photo induced shape memory polymers where in the temporary shape is fixed by exposure to light at specific frequencies.

Poonam Kharangarh, PhD Student in Physics, "Cell Accumulation in a Smart Shunt", (advisor Camelia Prodan and Gordon Thomas)

The primary treatment of excess fluid pressure in the cerebro-spinal system is the insertion of a shunt. We are engaged in a project to make a smart shunt that would indicate the condition of the brain fluid and its pressure release process. The principal cause of shunt failure is occlusion of the shunt, but the origin of the occlusion is not known. We have devised a method involving controlled micro-etching to uncover part of the sensors to allow a direct observation of the microscopic accumulation of cells. We have photographed the flexible capacitor plate inside the sensor to see the exposed surface directly. Our photomicrographs indicate that we can image the position at which the cells attach themselves. We flow a fluid through the sensor that replicates the cerebro-spinal fluid in the brain in its cellular and chemical composition. As the flow proceeds, it is known from observation of patients that the path through the shunt becomes occluded. Our experiments are indicating the first evidence of whether the occlusions arise from cell accumulation or from debris resulting from surgery to insert the shunt.

Kitae Kim, PhD Student in Transportation, "Variability of Travel Times on New Jersey Highways", (advisor Taha Marhaba)

This report presents the result of link- and path-based travel time variability (VTT) and distributions by departure time and day of the week on selected New Jersey (NJ) highways. The data collected by Global Positioning System (GPS)-equipped in-vehicle navigation systems in this study can be used to estimate the reliability of travel time, which provides a comparative measure on the predictability of the corresponding arrival time of a motorist's destination

Kwang Seok Kim, PhD. Student in Chemical Engineering, "Title of Poster: Two-Compartment Modeling And Computer Programs to Find the Optimal Intravenous Drug Dosage Regimens"
(advisor Laurent Simon)

A user-friendly computer program was developed to determine optimal drug-dosage regimens using a two-compartment pharmacokinetic model. The results are applicable for intravenous bolus injections (i.v. bolus) followed by a continuous infusion (i.v. infusion). To decrease the time it takes to reach a desired therapeutic plasma concentration while satisfying constraints (i.e., therapeutic window), the algorithm estimates the sizes of a set number of bolus doses given at specific times and the infusion rate. Published pharmacokinetic parameters, i.e., intercompartment transfer rate coefficients and apparent Michaelis-Menten constants of theophylline, were used to illustrate the methodology. Drug concentration profiles in the central (plasma) and peripheral cell compartments were solved by orthogonal collocation method in the *Mathematica*® (Wolfram Research, Inc.) environment. This technique has the potential to assist in providing customized patient care by helping to identify individualized drug doses that are both efficacious and safe

Shih-Yun Kuo, PhD Student in Chemistry &Environmental Science, "Environmental Worldviews and the New Ecological Paradigm: A Study of NJIT Undergraduate Students", (advisor Nancy Jackson)

Environmental world views are important indicators of human behavior toward the environment. A worldview is the overall perspective from which an individual perceives and interprets the world. Several scales have been developed to characterize how individuals relate to natural world, weigh limits to growth and identify the role of technology in solving environmental problems. Individuals who score high on these scales tend to view humans as part of nature and believe their exist limits to growth. Individuals who score low on these scales tend to believe that humans have the right to rule over nature and surpass growth limits. The New Ecological Paradigm Scale (NEP)(Dunlap et al. 2000) was used in this study to assess the ecological worldview of New Jersey Institute of Technology undergraduate students. A survey was administered to 388 students who enrolled in EPS 202 Society, Technology, and Environment during the 2008-09 academic year. The results suggest that NJIT students lean toward pro-environmental attitudes, but their scores on the NEP scale are lower compared to reported scores of students in other universities and disciplines.

Seon Woo Lee, PhD Student in Electrical Engineering, "Gate Controlled Negative Differential Resistance and Photoconductivity Enhancement in Carbon Nanotube Intra-connects", (advisor Haim Grebel)

Field effect transistors were fabricated using carbon nanotubes (CNT). Gate-controlled, N-shaped negative differential resistance (NDR) has been demonstrated. In addition, a large photoconductance effect was associated with the NDR. The intra-connects – bridges spanning across planar electrodes and contain individual tube or in a small bundle – were grown using chemical vapor deposition (CVD) precisely between very sharp metal tips on the pre-fabricated electrodes. NDR was observed for intra-connects exhibiting either, ohmic or, non-ohmic contacts. Yet, the enhanced photoconductivity was more pronounced for intra-connects exhibiting ohmic contact at zero gate bias.

Ling Lin, Junior in Biology, "Comparison of Stretch Growth in Adult and Embryonic Dorsal Root Ganglia", (advisor Bryan Pfister)

In an effort to treat spinal cord injuries, a method of bridging nerve lesions using mechanically stretched axons has been developed. One major concern of such method is whether they can function as normal axons, capable of myelination by Schwann Cells. The method thus far has utilized only embryonic Dorsal Root Ganglia neurons; since future clinical procedures will likely use the injured victim's own tissue, it is necessary to test the stretch-technique on adult DRGs. In this study, adult DRG neurons are being tested for their capacity for stretch growth and myelination by Schwann cells in vitro; furthermore, embryonic DRG's are also being tested for myelination and a comparison is made between their capacities for stretch. An axon-stretch device is used to stretch the axons in vitro and staining and visualization by microscopy is needed to examine the Schwann Cell-axon interaction and the possibility of myelination. Since adult cells generally are more developed and are rigid to change, it is expected that their capacity for stretch is less than that of the embryonic cells. Such study aims to perfect a promising form of treatment for spinal cord injuries.

Huiju Liu, PhD Student in Chemical, Biological & Pharmaceutical Engineering, "Study on the Dissolution of Indomethacin into Eudragit E PO Using a Batch Mixer", (advisor Costas G. Gogos)

There is a strong interest from both the academia and the industry to utilize hot melt extrusion (HME) for the preparation of solid solution of drugs and polymeric excipients, which can increase the dissolution rate and thus bioavailability of many poorly soluble drugs. However, drawbacks such as the degradation of active pharmaceutical ingredients (API) during the high temperature processing have limited broader applications of HME. Many APIs are heat sensitive, especially at temperatures above their melting point. This work studied the dissolution of indomethacin into the Eudragit E PO melt at temperatures lower than the melting point of the drug, whereby the melting of the drug did not occur. The effects of three process parameters (processing temperature, rpm and residence time) were studied. Scanning electron microscope (SEM), polarized optical microscope (POM) and X-ray diffraction (XRD) were used to qualitatively study the evolution of the drug particle size and the drug's crystallinity; differential scanning calorimetry (DSC) was used to quantitatively study the melting enthalpy evolution. The results from SEM, POM, XRD and DSC are consistent. The results show that all three processing parameters, processing temperature, rpm and residence time, play important roles for the dissolution of the drug into the polymeric matrix. The dissolution rate increases as the processing temperature increases and as the rpm increases. This work demonstrates that preparing the drug-polymer solution at a temperature lower than the drug's melting point provides a viable way to overcome the degradation issue.

Zhiming Liu, PhD Student in Computer Science, "Fusing Frequency, Spatial and Color Features for Face Recognition", (advisor Chengjun Liu)

This paper presents a face recognition method by fusing the frequency, spatial and color features for improving the face recognition grand challenge performance. In particular, the frequency features are extracted from the magnitude, the real and imaginary parts in the frequency domain of an image; the spatial features are derived from two different scales of a face image; and the color features are from a new hybrid color space, namely, the RIQ color space. Specifically, every color component in the RIQ color space has two scales: Scale 1 image and Scale 2 image (with a larger face region). First, the frequency feature extraction procedure applies to all the Scale 1 and Scale 2 color component images. Then, an improved Fisher model extracts discriminating features from the frequency data for similarity computation using a cosine similarity measure. Finally, the similarity scores from the three component images in the RIQ color space are fused by means of a weighted summation at the

decision level for the overall similarity computation. Experiments on the Face Recognition Grand Challenge (FRGC) version 2 Experiment 4 show that the proposed method achieves the face verification rate (corresponding to the ROC III curve) of 82.8% at the false accept rate of 0.1%, outperforming some recently published methods.

Joseph R. Loverde (partners with Vivian C. Ozoka), PhD Student in Biomedical Engineering, "Live imaging of extreme axon stretch growth," (advisor Bryan Pfister)

In a developing embryo, axons navigate via a growth cone over seeming large distances to reach their targets. However, well after axons integrate and establish synaptic connections, animals and their nerves undergo more rapid and significant growth. Our objective is to explore how stretching forces, associated with growth of an animal, initiate unique neurobiological mechanisms to accommodate stretch-growth of axons, driving the natural and rapid formation of long nerves.We hypothesize that protein translated in the soma undergo high-speed axon transport to accommodate the high demand of axon assembly and maintenance during stretch growth. Our current methods, however, cannot be adapted to visualize or quantify cellular or molecular processes in real time. A new bioreactor was developed for live and high magnification microscopy of axons as they undergo the stretch growth process. The central feature of this new system is a glass cover-slip bottom that accommodates the use of oil immersion lenses. The bioreactor serves as an incubator, maintaining physiological temperature and pH while imaging experiments are performed over hours to days. Temperature is controlled by a closed loop system utilizing a thermistor and heating element. pH is maintained by continuous perfusion of CO_2 and oxygen; pre-warmed and humidified to minimize temperature fluctuation and evaporation of media. Testing determined physiological conditions of 37º C +/- 1º C and pH 7.4 are maintained over one week of stretch growth. The complete stepper motor drive system and culture chamber can be operated entirely atop the stage of a confocal microscope. Furthermore, the culture chamber consists of 3 independent stretch growth lanes capable of running comparative studies.To demonstrate the ability to capture real time images of cellular events, mitochondria were labeled and visualized. Dorsal root ganglia explants plated onto the collagen-coated cover slip were stretch grown over 4 days to 1cm in length. Axons were successfully visualized along their entire length using a 60x oil immersion lens. Mitochondria were visualized and tracked within the axons using time-lapse software. The currently unstudied process of axon stretch growth may offer unique and significant contributions to our fundamental knowledge of nervous system development. Identification of targets, which may be used to exploit the stretch growth process, may be studied through use of viable tracking dyes or fluorescently labeled proteins. Discovery of a regulatory pathway could lead to new techniques in treatment of debilitating nerve injuries, where current techniques are insufficient to restore nerve function.

Karen Martinez, Senior in Chemical Engineering, "Application of the Maximum Mixedness Model To Simulate Fuel-Rich Combustion in Jet-Stirred Rector", (advisor Robert Barat)

In reactor engineering theory, maximum mixedness describes mixing of the feed into the flow vessel at the earliest time possible consistent with the Residence Time Distribution (RTD) of the vessel. The RTD describes the time fluid spends in the reactor, and accounts for degree of macro-mixing. In this project, we are using the Maximum Mixedness Model (MMM) to simulate fuel-rich combustion in a jet-stirred reactor that is nominally well-mixed

Susie Megalla, Junior in Biology, "Leukotoxin Production in Actinobacillus Actinomycetemcomitans", (advisor Karen Roach)

Aggregatibacter actinomycetemcomitans is a facultative coccobacillus gram-negative pathogen that is capable of colonization of the human oral cavity. Aggregatibacter actinomycetemcomitans was under

investigation to determine if the ltxC gene is required for leukotoxin activity in this bacterium. This activity causes a very aggressive form of periodontitis because it produces a leukotoxin that is specific for destroying white blood cells found in humans. To proceed, we began by isolating the specific region in the gene for this bacterium with primers that were specific to its genetic code. After isolating this specific region which codes for ltxC, we performed a variety of experiments to purify, amplify, and compare the effects ltxC has on certain culture conditions. We compared the effects of this natural strain of ltxC with that of a mutant strain of ltxC to determine whether this leukotoxin in its natural form is solely responsible for the effects on human white blood cells. This complementation helped us to make a comparison between two forms of ltxC and determine its characteristic behavior when found in A. actinomycetemcomitans.

Xiangxing Meng, PhD Student in Chemistry & Environmental Science, "Title: Simultaneous Anti-solvent Synthesis and Stabilization of Hydrophobic Drug Molecules in Biological Polymers", (advisor Som Mitra)

The enhancement of aqueous solubility and the dissolution rate of poorly water-soluble drugs is one of the major challenges during the drug development process. It has been proved that the dissolution rate and the bioavailability of hydrophobic drug are dependent on the particle size and the morphology. Finely dispersed drug particles in an aqueous media are easy to agglomerate and form large particles. Aggregation of the particles lowers the stability of suspension systems and the usage of stabilizing agents is necessary to overcome the stability problem. The type and amount of stabilizer may affect the stabilizing effect in the drug suspension systems. We found that combination usage of different cellulose derivatives and surfactants is effective under ultrasonic agitation during anti-solvent particle synthesis. In our work, we examined the effects of different cellulose ethers (MC, HEC and HPMC) and surfactant (SDS) on the stabilization of sub-micron particle suspensions created by anti-solvent method. The results show that mixed systems of cellulose ether and surfactant reduce particle size more effectively than that of only cellulose ether or the surfactant system. Moreover, Quantitative assessment of sedimentation behavior of two drugs (Fenofibate, Griseofulvin) based on particle size and sedimentation rate has been investigated in our work.

Stephanie Milczarski, PhD Student in Physics, "Dynamic Alignment of a Transpalpebral Tonometer to Monitor Glaucoma, (advisor Gordon Thomas)

Intraocular pressure (IOP) and visual field are the principle indicators of glaucoma. The best current method of measuring IOP involves touching the cornea with a sterile probe that requires an anesthetic and the supervision of an ophthalmologist. This measurement is typically only taken a few times per year, and IOP is subject to diurnal variations. We developed a tonometer that could be used by the patient for measurements often enough to ensure accuracy for diagnosis and measurement of response to medication. Our tonometer is head-mounted and measures IOP by a gentle touch on the eyelid. A key challenge with transpalpebral tonometry is accurately positioning the device in the center of the cornea. Our device takes continuous compressibility measurements and maps them as the eye moves with the eyelid kept stationary. With guided eye movement, this map determines the optimum position. Within seconds patients can find this position enabling them to improve the accuracy of self-administered IOP readings. The data show that our tonometer takes measurements at a rate of 12 IOP readings per minute. The reproducibility of our device is within a standard deviation of 0.5mmHg for one patient with an average IOP of 16mmHg, a statistical confidence that exceeds that of the current method. We have also shown that a subject is capable of collecting consistent, accurate IOP readings when he or she positions and operates the device. We have taken over 50,000 measurements on subjects at NJIT and patients at UMDNJ under the supervision of Dr. Robert Fechtner.

Catherine Morrison (partner with David Hamoui), Senior in Mathematical Science, "Predicting Plant Succession", (advisor Amit Bose)

Plant community succession is the at least somewhat predictable sequence of species compositions that follows a landscape disturbance (for example, clear-cutting). We assisted with the planning process for a proposed experiment to test whether this successional process is amenable to manipulation. First, we tested the magnitude of the influence of two kinds of stochasticity on the prediction of community composition from estimated Markov models of the successional process. The first kind of stochasticity comes from the probabilistic nature of the Markov process, although this is only a factor if individual plant species transitions are modeled (rather than proportions of species in an infinitely large population). The second kind of stochasticity comes from uncertainty about the true underlying Markov model, which can be incorporated if separate estimated transition matrices are available from different experimental plots, for example by the use of an interval, or "set" matrix. We drew conclusions about the appropriate number of plots relative to their size. Second, we examined the relationship between the history length of a successional process available to estimate its transition matrix, and the accuracy of predictions of community composition immediately following the estimation interval. We show how this relationship will differ for homogenous and non-homogenous Markov processes, and present some real-world examples.

Mohammad Nawaz, Sophomore in Biology, "Do membrane proteins plays any role in microspordia infection?", (advisor Camelia Prodan)

This research is about a very unique parasite called microsporidia. These parasites can remain dormant for many months, but once it is "awaken" under the right conditions, it will infect nearby host cells in an exceptional way. The way the infection happens is through what is called a "polar tube"; this is a very long tube that is literally launched from the parasite at a very high velocity and pierces the host cell. Once this step has happened successfully, the polar tube acts like a bridge between the parasite and the host cell. This allows genetic material to flow from the microsporidia through the tube and into the host cell for reproduction of the parasite. The objective of this research is to determine whether or not the proteins and other intramembranous molecules found on a host cell play a role in the infection. Using giant unilamellar vesicles, which are cell membranes without any molecules or proteins on it, is the best option to answer this question.

Sai Nudurupati, PhD Student in Mechanical Engineering, "Dielectrophoretic separation of particles at drop surfaces", (advisor Pushpendra Singh)

It was recently shown by us that particles distributed on the surface of a drop can be concentrated at its poles or the equator by subjecting it to a uniform electric field and that these concentrated particles can then be removed from the drop by increasing the electric field intensity. Here, we present experimental results which show that the dielectrophoretic force which causes this concentration of particles varies inversely with the drop radius which is in agreement with the recent analytical result. This implies that the effectiveness of the technique increases when the droplet size is decreased, and thus, for example, it is more effective for micro emulsions than for emulsions with larger sized droplets. Furthermore, the physical properties of the drop and ambient fluids and particles determine a critical drop radius such that if the drop radius is smaller than this critical value the electric field intensity needed for concentrating particles is smaller than the intensity at which the drop tip-streams. If the drop radius is larger than this critical value, it is not possible to concentrate particles because the drop breakup occurs at a smaller value of the electric field intensity. We also show that the technique can be used to separate particles experiencing positive dielectrophoresis on the surface of a drop from

those experiencing negative dielectrophoresis, and thus form a composite (Janus) drop by aggregating particles of one type near the poles and of another near the equator.

Mojisola K. Otegbeye, PhD Student in Industrial Engineering, "Dual Sourcing in a Volatile Commodity Market", (advisor Jian Yang)

We seek to derive commodity procurement policies tailored towards a manufacturer's risk attitude, where the price of the input commodity fluctuates and to mitigate his exposure to price volatility, the manufacturer seeks an optimal allotment policy for a dual procurement framework. The manufacturer can source his commodity needs through a contractual arrangement with a supplier as well as directly from the spot market. A risk sharing, win-win contract mechanism is proposed for the supplier-buyer relationship, and we seek to offer managerial insights as to how changes in the model's parameters ultimately affect the chain's efficiency. One of the highlights of our research's contribution to documented literature is the concept of a floating contract price, with the final price contingent on the future realization of the commodity's spot market price, in contrast to existing works where the contract price is fixed at the time of negotiation.

Vivian C. Ozoka (partners with Joseph R. Loverde), Master Student in Biomedical Engineering "Live imaging of extreme axon stretch growth," (advisor Bryan Pfister)

In a developing embryo, axons navigate via a growth cone over seeming large distances to reach their targets. However, well after axons integrate and establish synaptic connections, animals and their nerves undergo more rapid and significant growth. Our objective is to explore how stretching forces, associated with growth of an animal, initiate unique neurobiological mechanisms to accommodate stretch-growth of axons, driving the natural and rapid formation of long nerves.We hypothesize that protein translated in the soma undergo high-speed axon transport to accommodate the high demand of axon assembly and maintenance during stretch growth. Our current methods, however, cannot be adapted to visualize or quantify cellular or molecular processes in real time. A new bioreactor was developed for live and high magnification microscopy of axons as they undergo the stretch growth process. The central feature of this new system is a glass cover-slip bottom that accommodates the use of oil immersion lenses. The bioreactor serves as an incubator, maintaining physiological temperature and pH while imaging experiments are performed over hours to days. Temperature is controlled by a closed loop system utilizing a thermistor and heating element. pH is maintained by continuous perfusion of CO_2 and oxygen; pre-warmed and humidified to minimize temperature fluctuation and evaporation of media. Testing determined physiological conditions of 37º C +/- 1º C and pH 7.4 are maintained over one week of stretch growth. The complete stepper motor drive system and culture chamber can be operated entirely atop the stage of a confocal microscope. Furthermore, the culture chamber consists of 3 independent stretch growth lanes capable of running comparative studies.To demonstrate the ability to capture real time images of cellular events, mitochondria were labeled and visualized. Dorsal root ganglia explants plated onto the collagen-coated cover slip were stretch grown over 4 days to 1cm in length. Axons were successfully visualized along their entire length using a 60x oil immersion lens. Mitochondria were visualized and tracked within the axons using time-lapse software. The currently unstudied process of axon stretch growth may offer unique and significant contributions to our fundamental knowledge of nervous system development. Identification of targets, which may be used to exploit the stretch growth process, may be studied through use of viable tracking dyes or fluorescently labeled proteins. Discovery of a regulatory pathway could lead to new techniques in treatment of debilitating nerve injuries, where current techniques are insufficient to restore nerve function.

Nischal Padala, PhD Student in Biology, "Astrocytes Actively Modulate the Ability of Microglia to Become Antigen Presenting Cells", (advisor Mill Jonakait)

Microglia are hematopoetically-derived resident immune cells of the central nervous system. In the healthy CNS, they express negligible levels of MHC Class II molecules as well as co-stimulatory molecules CD40, CD80 and CD86 necessary for antigen presentation and T cell activation. These molecules can be induced in isolated microglia in vitro by sequential treatment with granulocyte monocyte colony-stimulating factor (GM-CSF) followed by lipopolysaccharide (LPS). Upon such treatment, they become mature dendritic cells (DCs), capable of efficient antigen presentation. However, microglia are not isolated in life, but rather exist in an environment enriched by other cells, notably astrocytes. Our data show that astrocytes play a critical role in modulating the activation of microglia. When mixed glial cultures are treated with GM-CSF and LPS, astrocytes, to a certain extent, suppress the expression of the DC marker CD11c, as well as MHC Class II, CD40, CD80, and CD86 as measured by flow cytometry. Astrocyte derived Prostaglandin E2 (PGE2) and interleukin 10 (IL-10) were tested as likely candidates since both inhibit LPS activation of isolated microglia. The addition of PGE2 failed to inhibit the expression of DC markers in either culture condition. To test the role of IL-10, microglia cultured in the presence or absence of astrocytes were treated with IL-10 or with neutralizing antibodies to IL-10. IL-10 did not significantly affect the expression of the DC markers. These data taken together suggest that astrocytes play a crucial role in mediating the expression of a mature DC phenotype in microglia and molecules other than PGE2 and IL-10 mediate the astrocytic action.

Rajesh Patel, PhD Student in Mechanical Engineering, "Modeling of Core Flow in a Gas-Solids Riser", (advisor Chao Zhu)

The heterogeneous flow structure in gas-solids riser reactors is typically represented by an upward solids flow in the core region and a back-mixing downward solids flow in the wall region. The hydrodynamic and reaction characteristics in these two regions are highly different, as most reactions with fresh catalyst solids occur in the core region and mostly spent catalyst solids are found in the wall region. Gross understanding on gas-solids riser flow can be conveniently obtained from a cross-section averaged one-dimensional modeling approach, which is probably only valid for the core region. The success of such an approach, however, has to rely on the appropriate modeling of controlling mechanisms of riser flows. Our recent studies show that commonly-employed Richardson-Zaki equation overestimates the hydrodynamic forces in the dense-phase and acceleration regimes; there is also a non-negligible effect of solids collision on solids acceleration, and the wall effect should be taken into account in terms of wall-boundary and back flow mixing. In this paper we propose a new mechanistic modeling to describe the hydrodynamics of upward flow of solids in a gas-solids riser, with new formula of hydrodynamic phase interactions. The modeling results are validated against published measurements of pressure and solids volume fraction in a wide range of particle property, gas velocity and solid mass flux. Parametric effects of operation conditions such as transport gas velocity and solid mass flux on hydrodynamic characteristics of riser flows are predicted.

Princy Pathickal (partner with Richa Dhawan), Junior in Biology, "Telomere Damage Induced Senescence in Organs of Aging Primates", (advisor Karen Roach)

Cellular senescence is the irreversible growth arrest that occurs in all human somatic cells and functions as a potent tumor suppressor mechanism. As senescent cells buildup, they may potentially contribute to the biological aging of organisms through the depletion of organ systems required to maintain homeostasis. A question raised is if telomere induced senescence contributes to tumor

suppression and organismal aging in aging baboon tissues and if cellular senescence affects multiple organ systems. Dysfunctional telomeres that have lost their protective function ultimately lead to senescence. It has been demonstrated in the lab that senescent cells containing telomere damage accumulate in aging baboons. As a result, the objective of the study is to determine whether the buildup of these senescent cells in aging animals is a factor leading to the functional decline of organs such as the heart and lungs that is observed in old age. The ultimate objective of the study focuses on the potential to impede the development of aging-related diseases such as diabetes through the manipulation of the senescence program in certain tissues without compromising the protection gained by cellular senescence.

Robert Pietrocola (partner with Joeseph DiNapoli), Senior in Architecture, "Newark Bus Rapid Transit", (advisor Darius Sollohub)

The Newark Bus Rapid Transit study results in a transit network that overlays the existing transit system present in Newark. Through community outreach and analysis of the existing system and research to investigate the urban fabric of Newark, we are able to develop a detailed transit network that becomes a catalyst for future transit oriented sites in Newark. In addition to BRT's inherent economy, efficiency and speed of deployment, there are other advantages to deploying it in Newark. Primary among these is that the City's urban pattern evolved around the streetcar network of the last century and that BRT can be readily deployed on these existing streets with minimal disruption. The second advantage is that Newark's residents already use buses extensively. In other cities in the US, where BRT is planned, ridership is often a trickle. In these places, patrons need to be coaxed from their cars and extraordinary measures are taken to package BRT to remove many of the negative connotations that many associate with buses. In Newark, improving service will be its own advertisement. Third, deployment has political and fiscal advantages at every level of government. As a mechanism of smart growth planning, BRT will likely receive endorsement if not support from State agencies. At the federal level, BRT is far more likely to be funded over lightrail in the New Starts Program. Finally, while it might be a minor coincidence, BRT as it is built worldwide was actually first conceptualized in Newark in the 1950's by PSEG and General Motors to replace the streetcar network that was highly interconnected into other regional infrastructure at Penn Station and other nodes. BRT could restore this functionality as well as restore the City's spirit of innovation.

Maria Plummer, PhD Student in Information Systems, "Recruitment in Social Networking Sites: Understanding Job Seekers' Perspectives", (advisor Starr Roxanne Hiltz)

Employers are increasingly turning to social networking sites (SNSs) to find job candidates or to gather intelligence about potential employees. It is important to understand jobseekers' reactions to recruitment efforts in SNSs because these sites present jobseekers with distinct advantages and disadvantages. A risk-benefit model is proposed for studying jobseekers' reactions to recruitment efforts in SNSs, and in particular, their behavioral intentions to apply for a job using these sites. This model integrates classic technology adoption/utilization theories with salient factors such as privacy concerns that have increased in significance with the growing use of SNSs as a recruitment source. Perceptions of online social network size along with the availability of information about social connections to potential employers are posited to have an impact on jobseekers' outcome expectancy and perceived usefulness of these sites. Online information privacy concerns are hypothesized to influence perceived justice/fairness of the job candidate selection process, which in turn, impacts perceived risks of applying for a job through these sites. Finally, this model predicts that perceived usefulness and perceived risks directly determine jobseekers' intentions to apply for a job using these sites. Data will be gathered from jobseekers in a survey-based study in order to test empirically the proposed model. This study will make a methodological and theoretical contribution to information

systems research with the development and validation of the model and the scales that will be used to measure its constructs. This study will also have practical implications for SNSs offering recruitment services; recruiters and potential employers; and jobseekers.

Abhishek Prasad, PhD Student in Biomedical Engineering, "Reconstruction of Elbow Joint Angles from Descending Signals in the Spinal Cord of Behaving Rats", (advisor Mesut Sahin)

Quadriplegia occurs due to trauma at the cervical level of the spine. This study shows that descending signals in the rubrospinal tract (RST) recorded above the level of injury can be utilized for extraction of volitional motor information. A15-channel microelectrode array (Cyberkinetics, Inc, UT) was implanted into the dorsolateral funiculus at C6/C7 level of the spinal cord in adult Long Evans rats. The rats were trained to reach and grasp for food through a small hole. Neural signals as well as video images of the animal were acquired simultaneously during face cleaning and reaching for food behavior. The rat's shoulder, elbow and forearm were marked manually in each video frame retrospectively. The elbow joint angle was calculated and plotted against the frame number and interpolation was used to curve fit the data. Principal component analysis (PCA) was performed on the neural signals. Tapped delay lines, i.e. sets of differentially lagged copies of each principal component (PC), were generated to account for variable delays for the neural signals to travel from the spinal cord to the forelimb. Multiple linear regression technique was used to reconstruct the elbow joint angles for each task from the rectified-averaged version of the tapped delayed PCs. The results suggest the potential use of spinal cord descending pathways for recording the volitional command signals to interface with a computer

Qinyin Qiu, PhD Student in Biomedical Engineering, "NJIT-RAVR system for Upper Extremity Rehabilitation in Children with Hemiplegia", (advisor Sergei Adamovich)

We describe the design and testing of a system that integrates rich virtual environments and assist as needed robotics to allow children with upper extremity impairments to perform rehabilitation activities in the form of computer games. Five simulations as well as positioning and interface approaches are described. To provide proof of concept we trained four children with mild to moderate upper extremity hemiplegia secondary to cerebral palsy. The children made improvements in clinical measures of upper extremity function and reaching kinematics as measured by the robot.

Nilufa Rahim, PhD Student in Electrical & Computer Engineering, "Elevated temperature breakdown study for high-k/metal gate stacks", (advisor Durga Misra)

Hafnium Oxide based high-k gate stacks are considered to be the potential candidates to replace SiO2 in complementary metal oxide semiconductor (CMOS) technology, specifically in the area of low power applications. To incorporate high-□ in CMOS devices, reliability studies need to be done systematically for high-□ layer and interfacial SiO2 layer. The soft spot in leading breakdown (BD) mechanisms in high-k/interfacial layer (IL)/metal gate stack has been claimed to be trap generation in the interfacial SiO2 layer. But to understand the breakdown characteristics of high-□/SiO2 gate stack completely it is important to study separately the role of SiO2 interfacial layers and bulk high-□ gate dielectrics without any interfacial layer, while maintaining same growth conditions. Also, reliability perspective of metal gate/HfO2/IL/Si high-k gate stacks can further be understood if the temperature dependence of time dependent dielectric breakdown (TDDB) is investigated.

In this work the temperature dependence of time dependent dielectric breakdown (TDDB) and stress induced leakage current (SILC) of high-k and interfacial (IL) layers are studied separately and in a gate stack with metal gates considering the breakdown mechanisms of these layers are different at higher temperature than at room temperature. As observed from the low voltage SILC, the interfacial

layer initiates the gate stack breakdown process at elevated temperature which is followed by the high-k layer. Activation energy extracted from Weibulll distribution of time-to-breakdown (TBD) data from high-k layer further suggests that the gate stack breakdown occurs when high-k layer ultimately breaks down.

Aminur Rahman, Junior in Applied Mathematics, "Discrete Dynamical Modeling and Analysis for the R-S Flip-Flop Circuit", (advisor Denis Blackmore)

A simple discrete model (in the form of a planar difference equation) for the Set/Reset flip-flop (R-S flip-flop) circuit is developed with an eye to replicating the dynamics of actual physical realizations of the circuit. Using dynamical systems theory and numerical simulations, it is shown that the model exhibits most of the qualitative features of actual circuit dynamics, such as sensitive dependence on initial parameters, oscillations among output states, periodic orbits of arbitrarily high period, and even chaos. It also is demonstrated that there is strong correlation between the discrete model and certain Poincare map like representations of the dynamics of continuous models of the actual physical circuit.

Arun Ramadass (partner with Srinivasamurthy Devayajanam), Master Student in Electrical & Computer Engineering, "Magnetic Augmented Rotational System – Application to Wind Mills", (advisor Nuggehalli Ravindra)

Traditionally, windmills have been designed to operate at a set range of wind speeds since wind is variable and site specific. This lowers the overall efficiency of the wind mill and makes operating costs high. The proposed setup utilizes a magnetically augmented rotation system for improving drive wheel and prime mover (i.e, wind power in this case) efficiency by operating at various wind speeds. Wind power is considered to be a promising and encouraging alternative for power generation because of its tremendous environmental and social benefits.

Paul Ray, (partner with Bernard Jones), Master Student in Emergency Management, "Critical Infrastructure and Key Resource (CIKR) Interdependencies", (advisor Mike Chumer)

Our research team will conduct a qualitative research study to develop a Critical Infrastructure Key Resource (CIKR) baseline interdependency report for the nine U.S. states that make up the All Hazards Consortium (AHC). Those states include: NJ, NY, PA, DE, MD, VA, WVA, NC, DC.

The report will identify existing multi-state planning organizations, existing multi-state tasks, and other efforts.

The report will also then become integrated into an AHC portal which will allow for the storage and cataloging of these resources segmented within the various areas that are collaborating for inter-state Critical Infrastructure Protection (CIP) coordination of efforts.

In summary, the many deliverables of this research study will make future regional incident response efforts much more efficient as well as move our region to becoming more resilient in the face of disasters.

Randy A. Reagan, PhD Student in Industrial Engineering, "Time-Value Model for Prioritizing New Product Development (NPD) Projects in Stationary Market Windows", (advisor Sanchoy Das)

Organizations responsible for technology-intensive New Product Development (NPD) face significant challenges when assigning resources across multiple projects where the market window for each product is stationary and where the product life potentials are relatively short and well characterized. This paper provides a time-value model that incorporates estimating variance into task duration

estimates and project schedule estimates and uses a triangular product life-cycle function anchored to a pre-defined potential launch date as a starting point for prioritizing resource assignment in multi-project environments where time-to-market is the primary success factor.

Bo Ren, PhD Student in Mathematical Sciences, "Portfolio Credit Risk Modeling and Quasi-Monte Carlo methods", (advisor David Horntrop)

Credit risk is the risk of losing contractually obligated cash flows promised by a corporation, financial institution, government, etc. (the counterparty) due to default on the debt obligations. The loss distribution of a credit portfolio strongly shows asymmetric behavior and a fat tail. It is not possible to fully diversify away this fat tail because of correlation. It is usually necessary to use Monte Carlo simulation to determine the loss distribution. For large inhomogeneous portfolios, the standard Monte Carlo simulation of the underlying stochastic processes may require days of computation time to provide sufficiently accurate calculations of tail events and tail statistics. So it is of substantial interest to accelerate the algorithms. We here present an approach that incorporates quasi-Monte Carlo methods into a multi-step setting for portfolio credit risk to achieve more effective and accurate modeling.

Ornthida Sae-Khow, PhD Student in Chemistry, "Micro Scale Solid Phase Extraction Using Carbon Nanotubes as Adsorbents", (advisor Som Mitra)

In this research we report the implementation of micro-solid-phase extraction (μ-SPE) in the needle of a syringe for integrating sampling, analyte enrichment and sample introduction into a single device. Both single- and multi-walled carbon nanotubes (CNTs) were explored as high performance sorbents for μ-SPE in packed and self assembled formats. The need for such a sorbent was critical because the needle probe could hold only a small amount of material (around 300_g). Conventional C-18 and self-assembled CNTs were found to be ineffective with enrichment factors less than one. However, packed beds of CNTs were found to be excellent sorbent phases, where high extraction efficiencies (as high as 27%) as well as enrichment factors (close to 7) could be achieved. The overall method showed excellent linearity, reproducibility, and low method detection limit (0.1–3 ng/mL for MWNTs). The sorption on CNTs followed Freundlich isotherms, and the functionalized CNTs were more effective for enriching the polar compounds.

Rimi Sahu, Senior in Biomedial Engineering, "Fabrication of Macroporous Silicon for Biomedical Applications", (advisor Mesut Sahin/Oktay Gokce)

Porous Silicon has found many of its properties in a wide range of technical field applications. These applications include sensors, light emitting diodes (LED), solar cells etc. Depending on the porosity and the nature of the pores, the macro porous silicon could have potential of being an efficient capacitor as compared to nonporous crystalline silicon. This property of macro porous silicon could produce a significant outcome if used in electronic implants which are used to study neural activities in animals.

Sherestha Saini, PhD Student in Chemistry &Environmental Science, "Transport of Horseshoe Crab Eggs and Sediment on a Sandy Foreshore in Delaware Bay, New Jersey", (advisor Nancy Jackson)

Delaware Bay is an important location for spawning horseshoe crabs and many shorebird species that migrate thousands of miles to feed on nutrient rich horseshoe crab eggs. Eggs released from the sand matrix are delivered to shorebirds via bioturbation and swash zone processes. Processes within the wave breaking and swash zones increase in importance for exhumation and transport when spawning densities are low. The mechanics of egg transport in the swash are not known. This study examines

the role of wave and swash processes in sustaining the link between horseshoe crabs and migratory shorebirds that are both under stress due to alteration of estuarine beach habitat.

Wave and swash velocities were measured over a spring tidal cycle. Dyed terrigenous sediment and horseshoe crab eggs were injected into the foreshore in locations where exhumation and transport is due to both the swash and breakers and swash processes alone. Total load traps were used to measure quantity of sediment and eggs transported over 110 individual swash cycles.

Wave and swash conditions exhumed and transported the largest numbers of eggs, from both injection sites, during the rising tide. Number of eggs trapped during the falling tide represented <3% of the total number of eggs trapped over the tidal cycle. Greater number of eggs and terrigenous sediment tracer was trapped from the injection site where both the swash and breakers transgressed past the injection point. Preliminary results reveal that terrigenous sediment tracer remains in the swash system but egg tracer is rapidly dispersed.

Soha Saleh, PhD Student in Biomedical Engineering, "FMRI Study on the Neural Mechanisms of Sensorimotor Transformations", (advisor Sergei Adamovicsh)

We used a blocked fMRI design to investigate the neural mechanisms of action planning in internal versus external space. The subject's arm was positioned alongside the body with the forearm semi-pronated. Vertical position of a cursor on the screen was controlled by finger flexion/extension measured with an MRI- compatible data glove. For each trial, subjects moved a cursor within from a centrally-positioned start to an upper or lower target. An MRI-compatible torque motor randomly rotated the forearm into pro/supination. In separate blocks, forearm rotation occurred before or after the target appeared, forcing a motor plan update based on target position or on forearm orientation, respectively. In control blocks, the target and forearm orientation remained consistent, so as not to require trial-to-trial re-planning. Re-planning in internal space was associated with activation in the left ventral premotor cortex and bilateral inferior parietal lobule. Replanning in external space was associated with activation in the superior parietal lobule. These data build on the role of premotor and parietal cortices in sensorimotor transformations.

Enrique Saro-Nuñez, Senior in Computer Engineering, "Implementing a Network on Chip forMIPS Processors), (advisor Sotirios Ziavraz)

The future of computer processors relies in the implementation of more and more processing cores in one silicon die. We have reached the physical limits of materials and running the computer clocks at higher speeds is no longer an option. With the addition of multiple cores in one chip, the communication between these cores will be more important than the computation they do. I propose to implement a Network on Chip. This will significantly reduce the number of wires to connect processors together. The network will be implemented using virtual queues. The use of virtual queues will significantly reduce the latency of the network and will increase the bandwidth of the wires. The goal of the project is to program a set of FPGA boards to simulate the Network on chip we create. We will use the MIPS processor presented in Hennessy and Patterson with a five pipeline stage. We plan to run several benchmarks to optimize the network and show how our results compare to other Network on Chip structures.

James V. Scicolone, PhD Student in Material Science and Engineering, "Magnetically Assisted Mixing of Nanosized Particles", (advisor Rajesh Dave)

Mixtures of nanoparticles and nanocomposites, manufactured using nanoparticles as building blocks, have unique properties owing to small particle/grain size, and large interface area between individual

nano-sized constituents. These properties have a great potential to improve performance of drugs, biomaterials, catalysts, energetic materials etc. However, to fully employ this potential, nanoparticles should be mixed at nanoscale level, which is a difficult task because they tend to form aggregates on the order of microns. Therefore, a major challenge in utilizing nanoparticles is to achieve their mixing at nano-scale level. The objective of this study is to explore the homogeneity of nanoparticle mixtures obtained using magnetically assisted mixing techniques. In this technique, nanopowders are placed along with sub-millimeter sized magnets in a container inside a coil producing an oscillating magnetic field. The magnets undergo rotational and translational motion and promote rearrangements of nano-particles between agglomerates of different materials, mixing them at scales below the aggregate size. Multiple parameters were studied to optimize the processes. Scanning Electron Microscope (SEM) equipped with Energy Dispersive X-ray Spectroscopy (EDS).

Anil Shrirao, PhD Student in Electrical Engineering, "Development of a hybrid microfluidic device for dielectric spectroscopy of live cells", (advisor Raquel Perez-Castillejos)

Dielectric spectroscopy is a non-invasive method for measuring the cell membrane potential, which is related to cellular viability, phenotype, and membrane-bound protein expression. Available experimental tools for performing dielectric spectroscopy are limited in their sensitivity, accuracy, and throughput. We will present our advances in the development of a microfluidic device with integrated thick-layer electrodes for single-cell dielectric spectroscopy.

Suarwee Snitsiriwat (partner with Anjani Gunuturu), PhD Student in Environmental Science, "Polycyclic Aromatic Hydrocarbons (PAHs) in intertidal sediments on the bay shoreline Sandy Hook, New Jersey", (advisor Nancy Jackson/Joe Bozzelli)

Polycyclic aromatic hydrocarbons (PAHs) are a significant class of organic pollutants related to fossil fuels having both anthropogenic and natural sources. They are present in fuels like coal, crude oil and gasoline; but the anthropogenic sources are more important as the PAHs are emitted to the environment as emissions from the combustion of fossil fuels, accidental oil spills, waste incineration and incomplete combustion with soot formation. The presence of PAHs in the environment is of growing concern due to their carcinogenic and mutagenic properties and their bio-accumulation in animal tissue, resulting from high partition coefficients. These persistent organic pollutants are hydrophobic in nature which effect bottom dwelling organisms forming an important connection between the sediments of the intertidal zone and the local food web, thus accurately reflecting pathways for PAH uptake[1].Most studies of PAHs in Raritan Bay have focused on the subtidal environment of the estuary. The purpose of this research is to determine the cross shore and alongshore presence and concentration of PAHs in intertidal sediments (to a depth of 0.20 m) at Spermaceti Cove, Horse Shoe Cove and Ferry Dock on Sandy Hook spit. These sites were chosen because previous investigations have documented PAH concentrations in subtidal sediments[2] and a national sediment toxicity survey identifies these areas of Sandy Hook as an area of high sediment toxicity (USEPA 1997). These studies were performed and the three sites were observed to have significant levels of accumulation of these toxic PAH's like naphthalene, anthracene, phenanthrene etc. This study involves wet sieving followed by microwave digestion, SPME and GC-FID analysis of the sediment samples. GC analysis of these samples showed significant concentrations of certain PAH's like phenanthrene and anthracene.

Keith Spengler, Junior in Applied Physics, "Saccharomyces Cerevisiae Under Pressure", (advisor Camelia Prodan)

Saccharomyces Cerevisiae, otherwise known as budding yeast, is a common fungi used in research endeavours. My research focuses on the effects of osmotic pressure on these cells. The pressure is

applied using a concentration of high molar sucrose, and the effect on the cells is instant. I will show the dependence of cell size versus osmotic pressure, and down the road I plan on studying the effects of the cell's long-term health when exposed to varying pressures over varying amounts of time. The motivation of this research is easily identified, as there are many diseases where the root causes are believed to be linked climbing pressures within the human body that may affect cellular health.

Sreeya Sreevatsa, PhD Student in Physics, "Permeable Bio-Electronic Carbon Nanotube Structures", (advisor Hiam Grebel)

DeoxyriboNucleic Acid (DNA) is a naturally occurring polymer found in genome coding. It is made of strongly bound double helix. Biophysical properties of such a polymer could be in principal ascertained by monitoring its role in the diffusion of ionic species. Single stranded DNA can be used to build a large molecular library, which can then be used to fabricate artificial and bio-inspired structures.

Carbon nanotubes are quasi one-dimensional crystalline structures. They exhibit high conductance and high strength properties. They may be made metallic or semiconductive depending on the tube's chirality. When wrapped around semiconductive carbon nanotube, single stand DNA turns the tube from p-type to n-type. Here we employ electronic and bio-electronic concepts in the control of ionic currents to and from a surface. Specifically, we examined the corrosion of metallic surfaces which are interfaced with nanotube based, alternate layers of p-type and n-type films.

The multi-layered permeable structure was introduced into an electrochemical cell. We monitored the corrosion current and corrosion potential in accelerated electrochemical experiments. DNA wrapped n-type CNT gives a conducting surface which can be used for protecting and monitoring the integrity of prosthetic metal devices, as well as enable us to build a variety of bio-molecules as thin films.

Ke Su, PhD Student in Physics, "Interferometric and Synthetic Aperture Real-time Terahertz imaging", (advisor John Federici)

Terahertz (THz) imaging systems for stand-off detection have many hardware challenges including the need for high-power illumination sources, detector sensitivity, and fast imaging speed. In this presentation, video-rate Terahertz imaging using synthetic aperture imaging method is demonstrated for the first time. A 4-element THz detector array is used to reconstruct 2-D images of a 0.1 THz continuous-wave point source at the rate of 63frames/s. The recorded video showing the movement of the terahertz source in real time is shown in http://solar.njit.edu/~zliu/video/moving_square.avi after baseline and phase correction. Furthermore, in order to improve the signal-to-noise ratio and achieve stand-off imaging at longer distances, a 94GHz high power source is integrated into this system and 7.4 meters imaging distance can be achieved. This work is supported by US Army, Picatinny Arsenal.

Graciela Terife, PhD Student in Mechanical& Industrial Engineering, "Cryogenic Mixing of Polymer/CNT Nanocomposites", (advisor Albert Narh)

Carbon nanotubes (CNT) are of great interest as reinforcement for polymers; their superior mechanical properties, high thermal stability and extremely high electrical conductivity together with their high aspect ratio suggest that polymer/CNT nanocomposites could combine the superior properties of the CNTs with the low cost and light weight of polymers in many applications. Even though a lot of research efforts have been put in this field, there is no single method to efficiently distribute and disperse CNTs in polymeric matrices. In this work, we explore the feasibility of the cryogenic milling process, as an environmentally friendly process, to produce polymer/CNT nanocomposites. A Linear Low density Polyethylene (LLDPE) was used as the matrix, and 1wt % of multi-walled carbon

nanotubes (MWCNT) was used as reinforcement, and the influence of the milling time and balls size was evaluated. The morphology and the degree of dispersion of the MWCNTs were studied using Scanning Electron Microscopy (SEM), optical microscopy and visual inspection; isolated bundles as well as aggregates of MWCNTs were observed, wetting of the nanotubes by the matrix was also evidenced. An increase of up to 28% with respect to the matrix in the elastic modulus (determined by tensile testing) was obtained. Differential scanning calorimetry (DSC) analysis showed evidence of increase in the degree of crystallization as well of the nucleating action of the CNTs in the matrix.

Gerardo Tolentino, Senior in Chemical, "Thermostability Studies of a Laboratory Evolved Biocatalyst", (advisor Edgardo Farinas)

The stability of the laccase CotA and an evolved mutant was investigated. CotA is found in the spore coat of *Bacillus subtilis*. This enzyme has applications in bioremediation, "green" chemistry, and biosensors. CotA was engineered for higher substrate specificity using laboratory or directed evolution. This process mimics natural evolution in a test tube, and it can be used as an efficient method for protein engineering. A mutant was identified to have a catalytic efficiency seven times greater when compared to the wild-type. Thermostability studies were performed to observe if mutations destabilize the protein. *B. subtilis* cells were sporulated, harvested, and purified. Thermostability was determined by measuring enzyme activity from 25^{o}C to 95^{o}C.

Samuel Tun, PhD Student of Physics, "Derivation of the magnetic structure of a solar active region using radio data from NJIT's OVSA observatory, the NRAO's VLA, and EIV/SXR diagnostics", (advisor Dale Gary)

Here we present work being done towards the reconstruction of the 3-dimensional structure of the magnetic field in the atmosphere above a solar active region. The algorithm uses data from NJIT's OVSA radio observatory and is aided by the use of data from various instruments. These include the National Radio Observatory's VLA, and several instruments aboard NASA's SOHO satellite. Knowledge of the magnetic field configuration of such regions is important to an understanding of dynamic solar processes that directly affect modern society.

Yavuz Ulusoy, PhD Student in Civil & Environmental Engineering, "Analysis of Integrated Transit Service for Minimum Cost Operation" (advisor Steven I-Jy Chien)

In large metropolitan areas, public transit is a major mode choice of commuters for their daily travel, which acts as an important role in relieving congestion on transportation corridors. The purpose of this study is to develop a model which optimizes service patterns and frequencies that yield minimum cost transit operation. Considering a general transit route with given stops and origin-destination (OD) demand, the proposed model consists of an objective total cost function and a set of constraints to ensure frequency conservation and sufficient capacity subject to operable fleet size. A numerical example is provided to demonstrate the effectiveness of the developed model, in which the demand and facility data of a rail transit route were given. Results show that the proposed model can be applied to optimize integrated service patterns and headways that significantly reduce the total cost, while the resulting performance indicators are generated.

Dennis Villegas, Senior in Biology, "Development of a model FRET Based Protein Kinase C biosensor", (advisor Marcel Bruchez, Carnegie Mellon University)

Molecular biosensors have the potential to further our understanding of the complex signal transduction pathways involved in our cells. Of particular significance are the protein kinases and phosphatases, a family of enzymes that add or remove phosphate groups to other target proteins, which are thought to play a significant role in the many pathways of cell communication. In order to

build a universal biosensor that could detect the addition or removal of a phosphate group, synthesis of a polypeptide chain is required with specificity towards a particular enzyme. This polypeptide backbone will not only contain amino acids, but will also include either terpyridine or hydroxyquinoline, which will serve as ligands. To quantify the effects of protein kinase C on our biosensor, we will examine the Fluorescence Resonance Energy Transfer (FRET), where the energy from the dye attached to the amino terminus of the peptide (Cy3) is transferred to another dye (Cy5) attached to the other end of the polypeptide, which will be made possible by the proximity of the two dyes in the synthesized strand due to the beta-hairpin conformation that the strand adopts in the presence of a divalent cation, such as zinc, a ligand, and a phosphate group. Successful laboratory experiments could ultimately lead to using this biosensor in vivo. By building a biosensor that could detect the phosphorylation or dephosphorylation effects of enzymes such as protein kinase c, we could gain a much deeper understanding of the complex signal transduction pathway in cells.

Edwin Walker, Senior in Chemical Engineering, "Theory and Experiment of a Forced Damped Oscillator", (advisor Michael R. Booty)

The world offers examples of systems that vibrate or oscillate. A few examples are: a swing in a playground, a pendulum, or a rocking chair. However, we encounter these systems in their more complicated forms within the fields of science, technology, engineering, and mathematics. Understanding these systems helps to make the following possible: the invention of the pendulum clock, understanding sound, the automotive suspension shock absorber and the behavior of some musical instruments. Therefore, it is important that oscillatory systems be investigated, studied and thoroughly understood.

Bin Wang, PhD Student in Civil & Environmental Engineering, "Bio-optical Characteristics of New York/New Jersey Harbor Estuary", (advisor Lisa Axe)

New York - New Jersey harbor estuary is designated an "Estuary of National Significance" by US EPA in 1988. Monitoring the water qualities, especially the algal communities, is a significant aspect to protect the water column of the Estuary. Ocean color is being monitored by integrated remote systems. Water quality (color dissolved organic matter (CDOM), chlorophyll a, and total suspended solids) can be derived from ocean color data using bio-optical and inverse modeling. The absorption coefficient is a primary inherent optical property (IOP) in marine bio-optical modeling and accounts for the water quality characteristics. Water samples were collected at 29 sites of the estuary during the Summer and Fall 2008. Absorption coefficients of phytoplankton, non-algal particles, and CDOM were measured. The mean SCDOM is 0.0168 m-1 (SD=0.0025) in NY/NJ harbor estuary with greater variation observed in summer as compared to fall. Jamaica Bay has greater particulate absorption coefficients (phytoplankton and non algal particulate) than that observed from other areas. Variation in the specific absorption coefficient for phytoplankton suggests significant diversity in pigment composition for the estuary. Further samples are needed to address seasonal and temporal water quality conditions.

Xiaoli Wang, PhD Student in Electrical & Computer Engineering, "Spreading Codes Enabling Warp Converging Wiener Filters for Multiuser Detection in CDMA System", (advisor Hongya Ge)

It has been shown in our previous work that for signal modes with a specially structured data covariance matrix, a warp (stable and predictable early) convergence can be achieved using the reduced-rank conjugate gradient (RRCG) Wiener filter (WF) for multi-user detection (MUD) in code division multiple access (CDMA) communication systems. In this work, we study various commonly used spreading codes that enable warp converging of the RRCG-WF. By analyzing the eigen-structure of the code set Grammian, we provide the exact number of convergence steps for different

code sets. It turns out that this number varies from 2 to 4 based on different spreading sequences, implying greatly reduced computational complexity of the RRCG-WF for MUD in CDMA systems.

Yimin Wang, PhD Student in Chemical, Biological & Pharmaceutical Engineering, "Velocity Distributions under Different Agitation Speeds", (advisor Piero Armenante)

The velocity distribution profiles in the USP Dissolution Testing Apparatus II vessel at impeller rotation speeds of 50 rpm, 75 rpm and 100 rpm in 900 mL of dissolution medium were experimentally measured via Laser Doppler Velocimetry (LDV) and computationally predicted via Computational Fluid Dynamics (CFD) using the □-□ model with low Reynolds number correction to account for turbulence effects. In general, the velocity distribution profiles from LDV measurements were in significant agreements with those from the CFD simulations in almost all regions of the vessel. When the local velocities were scaled with the impeller tip speed, the experimental velocity profiles at most locations were typically independent by the impeller speed. However, the non-dimensional axial and radial velocities were typically smaller at higher impeller speeds than at lower speeds. Irrespective of the impeller speeds, a low recirculation zone was observed in the lower part of the hemispherical vessel bottom where the tablet dissolution process takes place. In this region, the velocities were much smaller than in the rest of the vessel, and may or may not scale with impeller speed depending on the actual location and the velocity component.

Cindy Wassef, Sophomore in Biology, "Assessing Cancer Preventive Care in an Urban Clinic", (advisor Steven Keller, New Jersey Medical School)

Among physicians, much attention has been focused on documentation and charting. Clear physician documentation not only aids in providing quality care to patients but is also important for coding and billing. Clear medical records also help prevent medical errors and ensure that regular preventive services are administered. Despite its importance, little is known of the current state of medical records in family practices. In our research, we examined the screening rates for many preventive services and concluded that although cancer screening rates were relatively high, screening rates for other conditions showed a need for improvement. The next logical step in our research is to determine a way to improve these rates, both efficiently and effectively. Past studies have indicated that medical record organization, specifically flow sheets, yield the best rates of screening for preventive services. Unorganized charts and unclear documentation are directly correlated with missed screenings for preventive services. Many physicians cite time constraints during appointments as a reason for missed preventive screenings. With the aid of a flow sheet, physicians are better able to quickly see what services the patient has already received and proceed with the appropriate screening. Using the U.S. Preventive Services Task Force (USPSTF) guidelines, we have constructed a preventive care flow sheet to be inserted into charts at the Center for Family Health in Hoboken, NJ in hope of improving current screening rates.

Duo Wei, PhD Student in Computer Science, "Complex measure to track the evolution of the SNOMED hierarchy", (advisor Yehoshua Perl)

SNOMED CT is an extensive terminology with an attendant amount of complexity. Two measures are proposed for quantifying that complexity. Both are based on abstraction networks, called the area taxonomy and the partial-area taxonomy, that provide, for example, distributions of the relationships within a SNOMED hierarchy. The complexity measures are employed specifically to track the complexity of versions of the Specimen hierarchy of SNOMED before and after it are put through a sequence of auditing processes. The pre-audit and post-audit versions are compared. The results show that the auditing processes indeed lead to a simplification of the terminology's structure.

Aaron Wey, Junior in Biomedical Engineering, "Effects of In-vitro Environment on the Mechanical Properties of Biodegradable Fibers," (advisor Dr. Zohar Ophir)

Despite the common usage of metal stents, biodegradable stents provide an advantage of not staying in the body after their purpose is achieved. Biodegradable materials are affected by the in-vivo environment from the moment of insertion into the body. Several mechanisms, including chemical, physical, and biological, take place simultaneously and change the properties of the material. Modified PLA fiber samples were tested to determine their effective lifetime in-vitro. A series of tensile tests, weight measurements, and molecular weight measurements were carried out to determine degradation trends. The mechanical properties were affected initially by body temperature, and then by moisture absorption. Within a few days degradation started to play a significant role as the fibers were kept in the in-vitro environment for extended time.

Todd Will, PhD Student in Information Systems, "GRE: A Hybrid Recommendation Engine for NSDL", (advisor Yi-Fang Wu)

Recommendation engines have made great strides in understanding and implementing techniques to provide interesting and relevant documents to users. In this project, we complement two popular recommendation technologies, content-based (CB) and collaborative filtering (CF), with a knowledge-based (KB) recommendation technique and a text-based search system Lucene in a digital library setting. The CB engine uses the cosine similarity measure to calculate document similarity, while the CF engine utilizes the Markov model to recommend documents by identifying users with similar clickstreams. However, the main research effort in this project focused on designing a new KB engine to better understand the context of the user's current information need and then filter returned information accordingly; the KB engine requires less effort from the user in representing the search task than other KB designs and is the first of its kind implemented in a digital library setting. The experimental study compared the combination of CB, CF, KB, and text search to text search only by asking sixty subjects to perform two different tasks to find five relevant documents in a database composed of 212,000 documents from 22 NSDL collections. This combination of recommendation engines and text search substantially outperformed text search only, with the KB guiding users to better documents to fulfill the information searching tasks. A future study will consider the changing performance of CB, CF, and KB recommendation techniques over time and further allow for system customization to meet their individual information seeking needs and styles.

Jacek Wrobel, PhD Student in Applied Mathematics, "Algorithms for Recursively Rendering Parametric Curves", (advisor Roy Goodman)

In order to decrease the number of points needed to â€œcomputeâ€ a given curve, we propose to use higher-order interpolation techniques from geometric modeling. We use Bezier curves, one of the fundamental objects in curve design, to create an Adaptive Catmull-Rom Method. The method is based on a tolerance condition derived from properties of Bezier curves. Applying our idea along with previous methods to the simple problem of drawing a parametric curve shows faster converging and more efficient algorithm.

Tao Wu, PhD Student in Computer Science, "A Molecular Dynamic Modeling of Hemoglobin-Hemoglobin Interactions", (advisor Sheldon Wang)

In this poster, we present the results of our studies of hemoglobin-hemoglobin (Hb-Hb) interaction using model reduction methods. We begin by modeling Hb-Hb interaction with a simple spring-mass system with given parameters mass and stiffness. In this known system, we compare the mode superposition method with Singular Value Decomposition (SVD)-based Principal Component Analysis (PCA). Through PCA we are able to recover the principal direction of this system, namely

the model direction. This model direction will be matched with the eigenvector derived from mode superposition analysis. The same technique will be implemented in a much more complicated Hb-Hb interaction model, in which thousands of atoms in hemoglobin molecules are coupled with tens of thousands T3 water molecule models. The complex inter-atomic and inter-molecule potentials are replaced by nonlinear springs. We employ the same method to get the most significant modes and their frequencies of this complex dynamical system. More complex physical phenomena can then be further studied by these coarse grained models.

Haifeng Xiao, PhD Student in Electrical and Computer Engineering, "Data Mining of Modulation Types Using Cyclostationarity-Based Decision Tree", (advisor Yun Qing Shi)

In this research project, a decision tree has been established for successful data mining of modulation types of joint analog and digital modulated signals. The cyclostationary pattern and five features derived from the spectrum of the received communication signals are examined to formulate the decision tree in order to identify the modulation format. The developed decision tree structure has been tested with both digital and analog simulation data, and has demonstrated its promising performance.

Kuan Xu, PhD Student in Mathematical Science, (advisor Michael Booty/Michael Siegel)

The deformation and breakup of a drop or bubble in a slow viscous flow is a subject of fundamental importance. It is also of practical significance in many processes, such as the rheology of emulsions and mixing in multi-component fluid systems.In our investigation, we adopt the boundary integral method (BIM) in a complex-variable formulation. The geometry of the interface is kept two-dimensional and Cartesian to retain some of the available simplifications of complex variable techniques. Specifically, the Goursat representation of the flow was used, in which solution of the biharmonic equation for the stream function and all primitive variables are given by construction of a pair of complex analytic functions, which can in turn be found by constructing a single complex ``density" that satisfies a Fredholm integral equation of second type. Some recent study on the solvability of the resulting BIE are reported as well as several numerical examples, for which some high-order numerical devises have been employed, such asequal-arclength frame, spectral-accurate quadrature method and spectrum filter et al.

Min Yang, PhD Student in Chemical, Biological & Pharmaceutical Engineering, "Ethanol and Ethylene Glycol (EG) TPD on Pt/transition metal oxide nanoparticles: A metal-support interaction study", (advisor Xianqin Wang)

Renewable and environmental friendly bio-ethanol and biomass model compound ethylene glycol (EG) were used to produce H_2 for fuel cells over Pt supported on various transition metal oxide nanoparticles.

Ye Yang, PhD Student in Mathematical Sciences, "Reduced Order Models for Acoustoelastic Fluid-Structure Interaction Systems", (advisor X. Sheldon Wang)

In this poster, we employ fluid-structure interaction (FSI) systems with both immersed flexible structures and free surfaces to study singular value decomposition (SVD) based model reduction methods and traditional mode superposition methods. The stochastic noise is introduced in the system. The numerical results confirm that SVD-based model reduction methods are reliable by comparing the original transient solutions with recovered data composed by only a few dominant principal components. For acoustoelastic FSI systems, we employ a three-field mixed finite element formulation with displacement, pressure, and vorticity moment unknowns. The numerical examples

also demonstrate that this mixed finite element formulation can predict these frequencies and mode shapes without the contamination of nonphysical spurious nonzero frequencies.

Anna Zarow, PhD Student in Chemistry, "Raman Spectroscopy of Defected Griseofulvin in Powders and Films", (advisor Zafar Iqbal)

The particle size of the active pharmaceutical ingredient (API) plays an important role in pharmaceutical applications. Smaller particle size can lead to better dissolution properties and increase in surface area of the particles. One way to achieve smaller particle sizes is to use milling techniques. During the milling process, however, mechanical stress can induce changes in the crystal lattice, affecting physical and chemical properties of the active ingredient. Conventional Raman spectroscopy and Raman imaging were used to investigate possible defect formation in the pharmaceutical material, Griseofulvin, by milling. The appearance of a broad and intense background in the spectra recorded with 785 nm excitation suggests the formation of defects, which fluoresce in the near-infrared spectral region. Three different methods were used to effectively anneal or reduce the defects formed in the crystalline powders: exposure to high level of humidity, acetone dissolution followed by recrystallization, and laser irradiation. Analysis of low frequency Raman spectra associated with molecular deformation, rocking and wagging modes in milled and control samples of Griseofulvin also showed significant relative intensity differences in the Raman lines, which may be due to defect formation. Thin film strips prepared with Griseofulvin, sodium dodecyl sulfate, hydroxypropylmethyl cellulose, and glycerol were also examined by chemical micro-Raman imaging coupled with multivariate analysis to determine the uniformity of the drug distribution and the presence or absence of defects on the drug particles.

Han Zheng, PhD Student in Chemical, Biological & Pharmaceutical Engineering, "Process Control Research on Competitive Reactions in Confined Impinging Jets", (advisor Pierro Armenante)

Confined Impinging Jets (CIJ) is regarded as a relatively novel technology in chemical engineering. This instrument can be applied to mix chemical materials, to accelerate reaction rate, to extract nanoparticle from initial solution, and so on. This research focuses on two chemical reactions:

$$NaOH + HCl \xrightarrow{k_1} NaCl + H_2O$$

$$NaOH + ClCH_2COOC_2H_5 \xrightarrow{k_2} ClCH_2COONa + C_2H_5OH$$

As sodium hydroxide(NaOH) reacts with both hydrochloric acid(HCl) and ethyl chlorideacetate(ClCH2COOC2H5), these two reactions are competitive reactions. The yields of final products, NaCl and ClCH2COONa, are based on the reaction rate constants(k1 and k2). From previous research, neutralizations react very rapidly, while organic reactions usually take a longer time to produce the desired productions. If the confined impinging jets are applied in the competitive reactions, the data will be different from those under conventional conditions. According to the literal meaning, in the Confined Impinging Jets(CIJ) instrument, there are two jets with very small nozzles. Among the jets, one is for sodium hydroxide(NaOH) solution (concentration: 18mol/m3), while the other is for the mixture of hydrochloric acid(HCl)(concentration: 18 mol/m3) and ethyle chloroacetate(ClCH2COOC2H5)(concentration: 18 mol/m3) solution. During the experiments, sodium hydroxide(NaOH) solution is the limiting reactant, which means the flow rate of NaOH solution is kept constant. The process parameters changed in the research include the flow rate of mixture(HCl+ClCH2COOC2H5), and the power of sonication. The final products will be diluted and analyzed by Gas Chromatograph (GC). The concentrations of ethanol (C2H5OH) and ethyl chloroacetate(ClCH2COOC2H5), are used to calculate the yield of ClCH2COONa. The research aims to draw the conclusions of relationships between the product yield and the changed process parameters.