

Fourth Annual Provost's Student Research Showcase

Special Presentation by Wassim Jabi, Quentin Jones, Katia Passerini, Cristian Borcea, and Theodore Hall, “Fostering Creativity in Ubiquitous Social Computing through Casual and Formal Interactions in Interdisciplinary Design Studios”, Tables 1

This project aims to foster "CreativeIT": using information technology to enhance creativity in design, and applying creative design processes employed in disciplines such as architecture to enhance information technology. One aspect of this project is an interactive touch-screen poster display that enables two-way communication between designers, other team members, and the general public. Poster authors prepare their presentations in the form of web pages and submit the URIs to the display manager. The URIs are placed in an XML poster database on a networked server. The display kiosk software updates its poster list from the XML file periodically, displays the posters in sequence, and places thumbnails in a selection area. Viewers can give feedback on any poster that interests them through graffiti-style interaction with the touch-sensitive display, and e-mail the marked-up poster back to the author. This free-form feedback is a vital part of the creative process.

Ikemefuna Chukwuemeka Agbanusi, Senior Student in Mathematics, “Dissecting the Phase Response Curve of a Bursting Neuron”, (advised by Amitabha Bose, advisors Amitabha Bose, Farzan Nadim and Jorge Golowasch), Table 52

We define and analyze the Phase Response Curve (PRC) of an endogenous neuronal oscillator. The PRC measures how an oscillator responds to the timing of stimulus. We utilize a Morris-Leccar type model to reproduce some of the phenomena observed in laboratory experiments on the PD neuron in the Stomatogastric Ganglion of the crab, *Cancer borealis*. The PD neuron is a bursting neuron which means that its voltage profile has an active phase characterized by fast spiking activity and a silent phase. In particular, we reconstruct the PRC by analyzing the neuron's response in the active and silent phases separately and independently for particular types of stimulus.

Karina Aliaga, Junior Student in Math Biology (with Temitope Brotherson), “Island Biogeography with Active Dispersal”, (advised by Gareth Russell), Easel 16

MacArthur and Wilson's theory of island biogeography models the effect of distance and area of an island on the immigration and extinction rates of species, and therefore on equilibrium species richness. Like many classic spatial models in ecology, it assumes 'passive' dispersal and population dynamics. Here, we introduce the concept of emigration as a choice-based disappearance mechanism whereby species play an active role in deciding whether to leave, or remain on, an island. We link the emigration rate to both the area and distance of an island, using a variety of functional forms, and demonstrate how this function alters traditional species-area and species-distance relationships. We show how our modified model explains some otherwise puzzling patterns found in real data.

Fourth Annual Provost's Student Research Showcase

Yelda Alkan, PhD Student in Biomedical Engineering, “Cortical Location of Saccadic and Vergence Oculomotor Learning Revealed Using fMRI” (nominated by William Hunter; advised by Tara Alvarez), Easel 24

Motor learning is critical to the survival of all species and changes throughout life via neuroplasticity. The brain receives most of its information about the external world via the visual system. Saccadic eye movements are used to quickly shift the fovea to objects of interest using conjugate movements which are typically used during reading. The vergence system uses disconjugate movements of the eyes providing depth perception. This research will compare neural activity results during predictable and unpredictable visual conditions using functional MRI (fMRI) in humans during saccadic and vergence eye movements. There were three primary results from this research: 1) activation was observed in occipital, frontal, parietal, temporal, and cerebellar regions, 2) short-term neuroplasticity via recruitment and synchronization was observed in the cerebellar vermis 4/5 and 3) the frontal eye field and the parietal eye field had similar but also distinct areas of activity allocated for saccadic and vergence eye movements.

Rudina Bajrushi, Senior Student in Chemical Engineering, “Application of a Maximum Mixedness Model to Simulate a Turbulent Combustion Chamber”, (advised by Robert Barat), Easel 31

In this work, the authors have applied a maximum mixedness model to simulate published experimental data from a nominally well mixed turbulent combustion chamber. Novelty exists in the adaptation of this model to use with a detailed reaction mechanism. In addition, we have developed a maximum mixedness model enthalpy balance to predict combustion temperatures. Fully independent model predictions of temperature and species concentrations are compared to published experimental data. Preliminary conclusions suggest that the macromixing within the combustion chamber might be modeled best as a series of smaller continuous stirred tank reactors.

Amrita Banerjee (with Ruiqiong Li), PhD Student in Electrical and Computer Engineering, “Raman Spectrum of Graphene Coated Nano-Holes”, (advised by Haim Grebel), Easel 22

It was assumed in the past that graphene cannot exist in a free state form because it is thermodynamically unstable and would roll into carbon soot. Recently though, single and few layer graphene were made into films on substrates. At the same time, anodized aluminum oxide (AAO) gained interest for its organized nano holes structure. We combine these two elements in order to investigate nonlinear optical properties of graphene on AAO substrates. Surface enhanced Raman spectroscopy (SERS) is a widely used tool to study the vibration states of molecules. Periodic structures are sometimes used to couple the pumping laser light to surface charge waves. Such resonant conditions were utilized to analyze the Raman signal of carbon nanotubes and bio-species. Our intent here is different – we use the array of nano-hole in the AAO as a template to form periodic charge distribution in the graphene. Linear and nonlinear optical methods were used to

Fourth Annual Provost's Student Research Showcase

characterize such nano-system. The sample under test was tilted and rotated to achieve resonance conditions. We measured signal-to-noise (SNR) ratio for various conditions.

Angana Banerjee, Master Student in Biomedical Engineering, "Thermal and Morphological Analysis of Collagen-PLLA Electrospun Blends", (advised by George Collins), Easel 28

The objective of this research work was to produce and characterize blended nanofibers of a protein, collagen, and a synthetic polymer, poly (L-lactic acid). Such blended nanofiber scaffolds were produced by the technique of electrospinning and may have applications in tissue engineering, wound dressing and drug delivery. This study focuses on the in-depth analysis of the appearance of the structural relaxation occurring at the glass transition of PLLA in collagen-PLLA electrospun mats. In addition, the morphological characterization of the collagen-PLLA nanofiber mats was done and a hypothesis was developed on the solid state structure of the PLLA and collagen filament blends after they are electrospun.

Lauren Beach, PhD student in Chemical Engineering, "Effect of Dry Particle Coating on Packing Density of Cohesive Pharmaceutical Powders under Low Consolidation", (advised by Rajesh Davé), Table 49

Dry coating is an innovative technique in which nano-particles are mechanically coated onto the surface of larger (from a micron to few microns) host particles to impart useful properties to the final product, which are engineered particles. Dry coated engineered particles can have improved flow and handling properties, and hence are very useful for a number of industrial applications, especially in the pharmaceutical field. In this paper, we present preparation, characterization and applications of such engineered and modified particles to pharmaceutical applications. This precise coating of nano-particles on the surface of a larger carrier particle will cause reduction in the cohesion between two nano-coated particles. A reduction in adhesion is often directly proportional to an improvement in flow. Most available adhesive force models do not take in to account the effect of the Surface Area Coverage (SAC) by nano-particles. A simple model that accounts for the effect of guest (nanoparticle) coating on interparticle adhesion is derived based on the van der Waals interaction and the geometry: Cornstarch particles, with a mean size of around 15 microns are coated with 20nm hydrophobic fumed silica nanoparticles by Magnetically Assisted Impaction Coating, a dry particle coating method, to reduce the cohesiveness of the original powder. Acetaminophen, tolmetin sodium and Celphere (Spherical Multi crystalline cellulose) particles were also used as host particles. The weight percentage of additive is varied between 0.025% and 5%, which influences the cohesion of the coated powder. We examine the influence of the cohesion on packing density and other important properties. Flowability of fine powders is strongly dependent on memory effects such as the effect of previous consolidation stresses on the packing density of the powder. In this work we present

Fourth Annual Provost's Student Research Showcase

measurements of the particle packing density of fine cohesive powders as a function of the consolidation stress previously applied on the sample. Experiments are carried out using a novel vibration device for measuring the tapped density as well as the Sevilla Powder Tester apparatus, which is based on the use of gas flow either to fluidize to erase memory of the powder or to compress the bed in order to subject it to a controllable consolidation stress. The particle volume fraction is derived from the height of the bed, which is measured by a high-accuracy sensor placed on top of the vessel. It is observed that powders with lower amounts of coated additive have larger cohesion and form larger agglomerate structures and hence show lower packing densities. As amount of coated additive increases, cohesion is reduced and smaller agglomerates are formed which pack better in both fluidized and non-fluidized states. The effect of low consolidation stresses on the packing density is also examined. The packing density of a powder measured as a function of the consolidation stress (controlled through applied acceleration) increases as the amount of nanoparticle coating increases. This measurement is a meaningful indicator of the flowability of the powder, as powders that pack better tend to flow better. This is a more useful and better interpretable value than most currently used packed density devices. Detailed comparisons with other devices using a number of excipients are planned for the future. The addition/coating by nano-silica can greatly influence subsequent processes that powder undergoes. Further experimental and modeling studies are planned to examine the effect. Overall, lack of flowability is a continual problem in manufacturing processes of pharmaceuticals. By altering the flow characteristics of the powder, these manufacturing processes can be improved and using one or both of the aforementioned powder testing methods would help in further formulations by quantifying the improvement. Specific applications potentially include mixing and tableting and other manufacturing processes.

Ervin Beloni, PhD Student in Chemical Engineering, "Experimental Study of Ignition of Magnesium Powder By Electro-Static Discharge", (advised by E. Dreizin), Easel 33

Ignition sensitivity of powders to electro-static discharge (ESD) stimulation is commonly tested to assess the safety of powder handling. However, the mechanisms of powder ignition by electric spark remain unclear. This poster represents an experimental study in which the spark parameters are quantified and the ESD ignition of Mg powder is investigated. Spherical Mg powder was chosen for experiments because its thermal ignition kinetics was described in the literature, so that future quantitative interpretation of the present experiments is simplified. A commercially available apparatus for ESD ignition sensitivity testing was used in the study. Additional diagnostics enabled measurements of electrical current, voltage, and spark emission in real time. The optical emission was filtered to separate the signals produced by the spark plasma and by the heated material. The electrical circuitry producing the spark was calibrated to enable quantitative measurements of the spark current. The spark duration was of the order of a few μs . The spark current was always observed to have a

Fourth Annual Provost's Student Research Showcase

significant AC component. The oscillations in the current correlated with respective oscillations of the spark plasma emission. The oscillations could be described assuming that the spark had inductive impedance. The spark polarity was not observed to affect the heating of a metallic substrate and thus is not expected to affect powder ignition. In ignition tests, a portion of powder was observed to be ejected by the spark discharge so that a crater formed under the pin electrode. The ejection occurred with or without associated powder ignition. The minimum ignition energy determined for Mg powder was not affected by the used capacitor or by the use of a small amount of binder added to prevent the powder ejection. Experiments on Mg ignition showed a delay of the order of a few ms between the spark and the rise in the radiation signal due to the powder combustion. This delay was not affected by the used capacitor or by the discharge voltage when the discharge energy was selected at or above the minimum ignition energy level.

Ashish D. Borgaonkar, PhD Student in Environmental Engineering (with Krit Punburananon), "Spectral Fluorescent Signature Post Processing by PCA-MLR Technique to Predict the Concentration of Six DOM Fractions in Water", (advised by Taha Marhaba), Easel 19

Total Organic Carbon (TOC) analysis is not only important in studying disinfection byproducts (DBPs) precursors, but also, it can help regulate the discharge of organic chemicals in to a water body. However, six dissolved organic matter (DOM) fraction concentrations is a better measure for understanding of the organic character of water than the TOC of water, which is an aggregate parameter typically used by water purveyors. The experimental procedure for TOC fractionation is lengthy and tedious; therefore, many attempts have been made towards development of faster and reliable techniques. Marhaba et al. (2000) built a model using multiple linear regression applied to spectral fluorescent signature (SFS) for predicting the six-fraction concentration in water. SFS by definition is a three dimensional matrix that records fluorescent intensity for a range of emission and excitation wavelength co-ordinates in a pre-selected spectral window. Fluorescence is a very sensitive technique and works best only at certain wavelengths that are different for different materials. It is therefore difficult to quantitate a material using fluorescence technique, especially when the entire fluorescence matrix is considered, no matter what statistical technique is used. Addressing this difficulty, this research is an attempt to build an enhanced model by combining Principal Components Analysis (PCA) with multiple linear regression. This new model first reduces the dimensionality of the input data by focusing on specific portion of the entire matrix that contains the peak locations for all six-fractions. This model provides better sensitivity and accuracy, while maintaining the advantages of the earlier model, such as: rapid identification and quantification of DOM fractions. Potential use of the model is to determine the

Fourth Annual Provost's Student Research Showcase

problematic organic character of source water (e.g., DBPs precursors) and to optimize water treatment processes.

Corina Bot, PhD Student in Applied Physics, "Removing the Polarization Error in Dielectric Measurements", (advised by Camelia Prodan), Easel 29

The physiological membrane potential of cells is essential to maintain the proper biological functions. Changes in membrane potential occur when a drug is tested for delivery inside of a cell or if it can act as a channel blocker. This poster presents a noninvasive and fast method, dielectric spectroscopy, to measure changes in the membrane potential of live cell suspensions, in particular to *E. coli* as well as a novel method to remove the polarization error. Dielectric Spectroscopy can be applied to any cell suspension, regardless of size or shape, and is tested against the traditional one, voltage sensitive dyes. Polarization effect, caused by the ionic content of a buffer, contaminates the total impedance in the low frequency interval. Precise measurements of the complex dielectric permittivity require prior elimination of this error. Application of this method on different electrolytes and *E. coli* suspensions are exemplified here.

Temitope Brotherson, Junior Student in Math Biology (with Karina Aliaga), "Island Biogeography with Active Dispersal", (advised by Gareth Russell), Easel 16

MacArthur and Wilson's theory of island biogeography models the effect of distance and area of an island on the immigration and extinction rates of species, and therefore on equilibrium species richness. Like many classic spatial models in ecology, it assumes 'passive' dispersal and population dynamics. Here, we introduce the concept of emigration as a choice-based disappearance mechanism whereby species play an active role in deciding whether to leave, or remain on, an island. We link the emigration rate to both the area and distance of an island, using a variety of functional forms, and demonstrate how this function alters traditional species-area and species-distance relationships. We show how our modified model explains some otherwise puzzling patterns found in real data.

Lakshmi Chandrasekaran, PhD Student in Mathematics, "Analysis of Clustered Solutions in a Globally Inhibitory Network of Spiking Cells", (advised by Amitabha Bose), Easel 25

A neuronal network of cells may exhibit numerous patterns of activity some of which are quite complex and may play a major role in processing sensory information. We consider a globally inhibitory network based loosely on the architecture of the CA1 region of the hippocampus that contains an inhibitory neuron which synapses onto multiple uncoupled excitatory neurons. The inhibitory synapse is depressing. Each excitatory neuron is reciprocally coupled to the inhibitory neuron. Here we prove the existence and stability of 2 clustered solutions and generalize it to n-clustered solutions. Our analysis shows how synaptic depression allows the network to display a multistability of clustered solutions and also determines the interspike interval for these different types of solutions.

Fourth Annual Provost's Student Research Showcase

Ani Chintalapani, Senior Student of Biology (with Matthew Hanna), "Arf1 Dynamics in Cocksackievirus Infected Cells", (advised by Victor Mateev and Nihal Alton-Bonet), Easel 38

Coxsackie virus Type 3 (CVB3) like other entroviruses are single (+) stranded RNA viruses which use the cytoplasmic surface of intracellular membranes for RNA replication. Numerous studies have shown that Cocksackie virus replication is sensitive to the fungal toxin Brefeldin A (BFA), a well-characterized, highly specific inhibitor of Arf1 GTPase activation, but the capacity in which Arf1 assists the RNA replication is not understood. In uninfected cells active GTP-bound state Arf1 associates with nascent endoplasmic reticulum (ER) export domains, recruiting effectors whose activities, ranging from regulating membrane curvature and cytoskeletal machinery to signaling, result in the biogenesis of the ER-Golgi Intermediate Compartment (ERGIC) membranes which bud off and fuse with the Golgi apparatus. Given this, Arf1 activity in infected cells may also be utilized to specialized unconventional organelles for RNA replication. We have previously shown that in CVB3 infected cells Arf1 accumulates on discrete domains of the endoplasmic reticulum membranes which colocalize with viral replication machinery components. Here using fluorescence recovery after photobleaching techniques, we investigate the changes in Arf1 membrane binding and dissociation rates in single living cells at different time points during infection. With these rates and our measurements of the abundances of Arf1 at these accumulated domains, we generate a model of Arf1 dynamics in CVB3 infected cells.

Mario Derevjanik, Senior Student in Chemical Engineering (with Mark Materna), "Catalytic Packed Bed Reactor System for Chemical Engineering Undergraduate Laboratory", (advised by Robert Barat), Easel 20

In this work, the authors constructed and operated a packed bed catalytic reactor system for use in the undergraduate chemical engineering laboratory. The system consists of feed preparation, reactor, and on-line gas chromatography. The chemical reaction currently being used is the hydrogenolysis of propane to ethane and methane. The utility of the system allows for a change to another chemical reaction in the future, if desired. While this work has not been presented in a public forum, the results are consistent with those observed in the literature. This work was unfunded, and relied on use of existing resources. The authors thank the Otto York Dep't of Chemical Engineering for its support in buying compressed gases, and facilitating needed utilities.

Gaurav Devrani, Master Student in Electrical Engineering (with Sudhakar Shet), "Modeling of Magnetic Field Assisted Assembly", (advised by Ravindra Nuggehalli), Table 46

Methods of magnetic field assisted assembly for the manufacture of semiconductor systems are summarized. Experimental techniques for the

Fourth Annual Provost's Student Research Showcase

assembly process are described with examples. A two dimensional modeling scheme, using VIZIMAG, is developed for the magnetic field assembly process.

Ezinwa Elele, PhD Student in Chemical Engineering, "Electro Hydrodynamic Filtration of Polarizable Microparticles in a Flowing Suspension", (advised by Boris Khusid), Easel 26

Dielectrophoretic force due to particle polarization in an inhomogeneous electric field is a phenomenon that has been utilized in various micro devices to segregate polarizable microparticles. We present an electro hydrodynamic filter which combines both dielectrophoretic and mechanical removal of particulates in a flowing suspension.

Leonardo Espin, PhD Student in Applied Mathematics, "Effect of Inlet Boundary Conditions in Some Self-Similar Solutions of the Navier-Stokes Equations in Bounded Domains", (advised by Demetrius Papageorgiou), Easel 41

We investigate the effects that different inlet boundary conditions have in the development of the solutions of the Navier-Stokes equations in a two-dimensional, finite channel with accelerating walls. When the channel is infinite, the Navier-Stokes equations admit solutions of the similarity form, which as previous studies have shown, may or may not be recovered depending on the form of the inlet conditions. We find that even in the case when the inlet profiles are of the similarity form, the Navier-Stokes equations admit solutions which present a behavior which differs considerably from the one expected from the similarity solutions. As an example we show an unstable branch of solutions of the simpler, similarity model, which emerges as a stable branch for the Navier-Stokes equations.

Maria N. Erazo, Senior Student in Chemical Engineering, "A Temperature-Controlled Release Strategy for the Release of Ethyl 4-AminoBenzoate through Ethylene-Vinyl Acetate Membranes", (advisor Dr. Laurent Simon), Table 3

In general, a controlled-release device can be engineered for the specific delivery rate of a drug to its target site. This basic concept can be easily understood by conducting permeation experiments with Franz diffusion cells. In this study, the drug Ethyl 4-AminoBenzoate (Benzocaine) is diluted into 20%, 30% and 40% Polyethylene Glycol (PEG) 400, the solvent. The saturated Benzocaine solutions are then circulated through an Ethylene-Vinyl Acetate (EVA) membrane from a donor to a receptor cell at a fixed temperature. Concentrations of the collected samples from the receptor chamber are obtained by using both a spectrophotometer and the data collected from calibration. From the results gathered, one may be able to estimate the solvent concentration and temperature necessary to maintain a specific drug delivery rate during the therapeutic period. Conversely, given a delivery rate, a device can be manufactured to meet patient needs.

Fourth Annual Provost's Student Research Showcase

Matthew Hanna, Senior Student of Biology (with Ani Chintalapani), "Arf1 Dynamics in Cocksackievirus Infected Cell", (advised by Victor Mateev and Nihal Alton-Bonet), Easel 38

Cocksackie virus Type 3 (CVB3) like other entroviruses are single (+) stranded RNA viruses which use the cytoplasmic surface of intracellular membranes for RNA replication. Numerous studies have shown that Cocksackie virus replication is sensitive to the fungal toxin Brefeldin A (BFA), a well-characterized, highly specific inhibitor of Arf1 GTPase activation, but the capacity in which Arf1 assists the RNA replication is not understood. In uninfected cells active GTP-bound state Arf1 associates with nascent endoplasmic reticulum (ER) export domains, recruiting effectors whose activities, ranging from regulating membrane curvature and cytoskeletal machinery to signaling, result in the biogenesis of the ER-Golgi Intermediate Compartment (ERGIC) membranes which bud off and fuse with the Golgi apparatus. Given this, Arf1 activity in infected cells may also be utilized to specialized unconventional organelles for RNA replication. We have previously shown that in CVB3 infected cells Arf1 accumulates on discrete domains of the endoplasmic reticulum membranes which colocalize with viral replication machinery components. Here using fluorescence recovery after photobleaching techniques, we investigate the changes in Arf1 membrane binding and dissociation rates in single living cells at different time points during infection. With these rates and our measurements of the abundances of Arf1 at these accumulated domains, we generate a model of Arf1 dynamics in CVB3 infected cells.

Laila Jai Jallo, PhD student in Chemical Engineering, "Particle Surface modification and characterization", (advisor Rajesh Dave), Table 53

Dry particle coating with silica and wet coating with silane was used to modify the surface characteristics of aluminum powders. The results of the surface modification were quantified/qualified by measuring the flowability of the powders using the Sevilla Powder Tester, the surface topography using Atomic Force Microscope and the surface energies using Inverse Gas Chromatography. Using the surface energies, the force of attraction between the particles was calculated.

Sidharth Kapoor, Senior Student in Biomedical Engineering, "Incorporating Multiple Microencapsulated PCMs on Fabric to Maintain Skin Temperature", (advisor Max Roman), Table 5

The purpose of this study is to incorporate microencapsulated phase change materials (micro-PCMs) in fabric in order to regulate skin temperature when fluctuations in the environment and body occur. Using multiple PCMs in clothing can provide the users with a comfortable temperature range from shivering (31oC) to core body temperature (37oC). Organic PCMs incorporated into the fabric are Paraffin products: n-Octadecane and n-Eicosane. The PCMs are coated onto a cotton fabric. The PCM fabric will be examined and compared to fabric containing no PCMs when testing for thermal abilities and fabric strength.

Fourth Annual Provost's Student Research Showcase

Mugdha Khaladkar, PHD Student in CS and Bioinformatics, "RADAR: A Framework for Structure Mining and Motif Discovery in Functional RNAs", (advised by Jason Wang), Table 4

Comparing and aligning RNA secondary structures is fundamental to knowledge discovery in biomolecular informatics. It assists scientists in performing many important RNA mining operations, including the understanding of functions of RNA sequences, the detection of structural RNA motifs and the clustering of RNA molecules, among others. RADAR is a web-based toolkit for RNA data analysis and research. The toolkit is capable of performing database search, multiple structure alignment, and pair-wise structure comparison. In addition, RADAR provides two salient features: (1) constrained alignment of RNA Secondary structures, and (2) prediction of the consensus for a set of RNA secondary structures. It is fully operational and accessible on the web at <http://datalab.njit.edu/biodata/rna/RSmatch/server.htm>.

Seon Woo Lee, PhD student in Electrical and Computer Engineering, "Single Electron Devices Based on As-Grown Individual Carbon Nanotube Bridges and Conductive Polymers", (advised by H. Grebel), Table 50

Carbon nanotube (CNT) and electrically conducting polymers (ECP) have gained much interest recently, each component for its own merit. Here we combined these two material components in the realization of optoelectronic circuits on the nano-scale. CNT Field-Effect Transistors (CNT-FET) were fabricated by combining as-grown CNT intra-connects and ECP. Intra-connects (bridges) were realized on a pre-patterned and addressable electrodes layout by using chemical vapor deposition (CVD) process. These were later electroplated with ECP by using conventional three-compartment electrochemical cell. The morphology, electrical conductivity, photoconductivity, optical properties were studied by Raman spectroscopy, Scanning Electron Microscopy (SEM), photoconductivity measurements, current-voltage (I-V) and current-gate voltage (I-V_G) measurements. The CNT bridges grown by CVD were well-aligned from tip to tip and the electrical conductivity was measurable without further processing. The results for all measurements were compared before and after electrochemical deposition of the ECP. Such construction may find applications in optoelectronic switches and radiation sensors on the nano-scale.

Daniel Lepek, PhD student in Chemical Engineering, "Nanofluidization as affected by Vibration and Electrostatic Fields", (advised by Rajesh Dave and Robert Pfeffer), Easel 44

In this talk, the behavior of a fluidized bed of silica nanoparticles under the influence of externally applied vibrations and electrostatic field will be presented. It has been observed that the application of these fields separately has opposite effects on bed expansion. On one hand, vertical vibrations enhances bed expansion as the vibration intensity is increased up to a critical value. On the other hand, an electrostatic field applied in the horizontal direction, hinders bed

Fourth Annual Provost's Student Research Showcase

expansion. In previous research papers, it has been suggested that the size of nanoparticle agglomerates could be affected either by vibration or by the action of the electric field. Using the modified Richardson-Zaki method to analyze our experimental data, we find that vertical vibration tends to decrease the average agglomerate size in agreement with previous research. However, in this work we look further into the physical mechanisms which affect the response of the fluidized bed. Our results suggest that both vibration and the electric field produce a significant perturbation to the flow of agglomerates on the fluidized bed. Vibration transmits a vertical motion to the agglomerates that enhances bed expansion until vibration velocity becomes of the order of the expected rising velocity of macroscopic bubbles. At this critical point, bubbles growth is stimulated by vibration. A horizontal electrostatic field produces a drift of the charged agglomerates towards the walls that gives rise to fluidization heterogeneity and bed collapse. When both fields are jointly applied these opposed effects can be practically compensated.

Ruiqiong Li, PhD Student in Electrical and Computer Engineering (with Amrita Banerjee), “Raman Spectrum of Graphene Coated Nano-Holes”, (advised by Haim Grebel), Easel 22

It was assumed in the past that graphene cannot exist in a free state form because it is thermodynamically unstable and would roll into carbon soot. Recently though, single and few layer graphene were made into films on substrates. At the same time, anodized aluminum oxide (AAO) gained interest for its organized nano holes structure. We combine these two elements in order to investigate nonlinear optical properties of grapheme on AAO substrates. Surface enhanced Raman spectroscopy (SERS) is a widely used tool to study the vibration states of molecules. Periodic structures are sometime used to couple the pumping laser light to surface charge waves. Such resonant conditions were utilized to analyze the Raman signal of carbon nanotubes and bio-species. Our intent here is different – we use the array of nano-hole in the AAO as a template to form periodic charge distribution in the grapheme . Linear and nonlinear optical methods were used to characterize such nano-system. The sample under test was tilted and rotated to achieve resonance conditions. We measured signal-to-noise (SNR) ratio for various conditions.

Bin Lin, Senior Student in Biomedical Engineering(with Vivian Ozoka) , “Axon Stretch Growth Device for Real Time Imaging”, (nominated by McNair Program Mentor Dr. A. Perna, advisor Bryan Pfister), Easel 13

It has been postulated that axons are forced to increase in length during human development, implying that mechanical forces play a crucial role in axonal elongation. Moreover, once human development is complete, axons cease to grow. (Pfister et. Al) Therefore, a severed nerve could neither regenerate nor elongate by itself. The purpose of this project is to design a miniature version of preexisting axon stretch growth device that can stretch damaged axons in vitro to a length such that it can be implanted into the site of injured area to bridge the

Fourth Annual Provost's Student Research Showcase

nerve gap. The device is small enough to sit on the stage of the microscope which allows the axons to be view while being stretched mechanically. The device will allow researchers and scientists to view and image the axon stretch growth process in real time underneath a high power microscope. As a result, the experimentalists will be able to analyze and investigate axon structure in great detail. Furthermore, scientists and researchers will be able to determine exactly which biological factors affect axon growth.

Sheng Liu, PhD Student in Applied Physics, "A Smart Shunt for Head Injury/Hydrocephalus", (advised by Gordon Thomas), Easel 39

We have developed a device to improve treatment of excessive fluid pressure resulting from cerebro-spinal injury and hydrocephalus. We have shown that our implantable device operates successfully with adequate sensitivity using wireless communication. This device will help head injury/hydrocephalus patients monitor the flow and pressure of the cerebro-spinal fluid. With that indication, quick response would substantially reduce neural damage. Also, with that indication, unnecessary operations would be eliminated.

Mark Materna, Senior Student in Chemical Engineering (with Mario Derevjanik), "Catalytic Packed Bed Reactor System for Chemical Engineering Undergraduate Laboratory", (advised by Robert Barat), Easel 20

In this work, the authors constructed and operated a packed bed catalytic reactor system for use in the undergraduate chemical engineering laboratory. The system consists of feed preparation, reactor, and on-line gas chromatography. The chemical reaction currently being used is the hydrogenolysis of propane to ethane and methane. The utility of the system allows for a change to another chemical reaction in the future, if desired. While this work has not been presented in a public forum, the results are consistent with those observed in the literature. This work was unfunded, and relied on use of existing resources. The authors thank the Otto York Dep't of Chemical Engineering for its support in buying compressed gases, and facilitating needed utilities.

Xiangxing Meng, PhD Student in Chemistry, "Synthesis of Nano Drug Particles Followed by Immobilization in Polymer Films for Drug Delivery", (advised by Somenath Mitra), Easel 21

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 solubility and the bioavailability of hydrophobic drug are dependent on the particle size and the morphology. Small size particles have higher solubility due to increased surface area and higher surface free energy. As a result, considerable efforts have been directed towards developing reliable and efficient methods to manufacture stable and fine particles. In this study, Anti-solvent synthesis of nano/micro scale drug particles (Fenofibrate, Griseofulvin) with simultaneous stabilization using different biopolymers and surfactants in aqueous media has been investigated. The stability of the drug suspensions have

Fourth Annual Provost's Student Research Showcase

been performed with the study of nanoparticles growth and sedimentation behavior. The combination of ultrasonic agitation and anti-solvent method is found to be quite effective for the synthesis of micro/nano drug particles. The result shows that a mixture of cellulose based polymers and a surfactant reduces particle size more effectively than either only cellulose or a surfactant. Drug-loaded polymer films were prepared by a casting/solvent evaporation technique from drug particle suspension. Characterizations of those films have been investigated by Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), Scanning electron microscope (SEM).

Stephanie Milczarski, Senior Student in Applied Physics, “Characterization of a Device to Measure Eye Pressure through the Eyelid”, (advised by Gordon Thomas), Easel 32

Pressure increases in the eye are correlated with glaucoma and the associated loss of vision. Consequently, the control of this intraocular pressure is the principal treatment. The best current method to measure eye pressure involves touching the cornea with a sterile probe that applies a very small force. This measurement is challenging and requires the supervision of an ophthalmologist. We are conducting a clinical trial to test a new method that measures compressibility through the eyelid with a new instrument. Because the new method does not impact the cornea, a patient could use it at home to monitor diurnal pressure variations and the efficacy of treatments. Initial results indicate that the new method has adequate sensitivity. With the extant method, we have identified a key source limiting the reproducibility of the measurement of intraocular pressure. We have devised an improved device that operates in the frame of reference of the head. This poster describes our progress with gathering data to quantify the new reproducibility and related parameters with sufficient statistical confidence. We are studying subjects at NJIT and patients at UMDNJ with the supervision of Dr. Robert Fechtner and his colleagues, under a grant from the New Jersey Commission on Science and Technology.

Jon K. Morgan, Masters Student in Information Systems, “Three Dimensional Visualization for Emergency Preparedness Training and Immersive Environment Gaming”, (advised by Murray Turoff), Table 47

The system provides a three dimensional virtual city in which emergency events can be simulated. The virtual city provides a real-time gaming environment that offers shared situational awareness and full immersion into the environment. The system attempts to foster improved communication, realistic simulation of the event, and identify and record core competencies in order to improve emergency preparedness training.

Shilan Motamedvaziri, PhD Student in Chemical Engineering, “AC Electric Field driven in order to printing drug dosage”, (advised by Boris Khusid), Easel 37

Experimentally and theoretically AC electric field driven to produce precise droplets from Polyethylene Glycol (PEG), which is widely used as solvent in

Fourth Annual Provost's Student Research Showcase

pharmaceutical industries. In the first set of the experiments, precise droplets from PEG 200, which is fluid in the room temperature, has been studied. Finally by using these approach and adding heating device, the droplet shape and size from suspension drugs into PEG 3,350 which is not liquid in room temperature will be examined. The evolution in time of the droplet shape has been recorded using a high-speed camera.

Nebojsa Murisic, PhD Student in Applied Mathematics, "Title of my poster: "Octopus"-shaped Instabilities of Evaporating Drops: Experiments and Theory", (advised by Lou Kondic), Easel 45

The motivation for this work stems from curious phenomena recorded in semiconductor industry. We report on instabilities during the spreading of volatile liquids, with emphasis on the novel instability observed when isopropyl alcohol (IPA) is deposited on a mono-crystalline Si wafer. The instability is characterized by emission of smaller drops ahead of the expanding front, with each smaller drop followed by a cloud of even smaller satellite droplets, forming structures which we nickname "octopi" due to their appearance. A less volatile liquid (DIW), or a solid having larger heat conductivity (Cu), are found to suppress this type of instability. We formulate a theoretical model, based on Navier-Stokes equations, and use lubrication approximation to obtain the equation for evolution of drop thickness. Linear stability analysis(LSA) of the full equation tells us that, indeed, IPA/Si set-up is most unstable. Finally, we compare our numerical results to experimental data. We find that our model reproduces the main features of the experiment, and relate them to evaporation induced Marangoni effects and thermal conductivity of both liquid and solid.

Mohammad Nawaz, Freshman Student in Biology, "Construction of Giant Lipid Vesicles through Electroformation", (advised by Camelia Prodan), Table 8

This experiment explores the production of giant vesicles through electroformation. Vesicles are small organelles, which are made up of the same molecule as the plasma membrane, used to transport materials within the cell. When these molecules (phospholipids) and water are put in to an electroformation chamber, which consists of two platinum wires with running electricity, the phospholipids make tiny vesicles that are induced to join neighboring vesicles to form even bigger ones. Essentially, electroformation forms giant vesicles that are the size of cells, just without the proteins on the membrane and without the organelles within the cell.

Jillian Nguyen, Senior Student in Biomedical Engineering, "Oculomotor Tracking Trough Vergence and Saccadic Eye Movements Uing fMRI", (nominated by the McNair Program, advisor Tara Alvarez), Easel 35

Oculomotor dysfunction is prominent in a number of traumatic brain injury (TBI) patients, as well as in the general populace. With the brain's dependence on the visual system to receive information from its peripheral environment, it is imperative to understand the basic science of the oculomotor system in order to

Fourth Annual Provost's Student Research Showcase

quantify which areas of the brain are associated with it. In doing so, it is anticipated that comprehension of the plasticity of the brain in accordance with oculomotor tracking will lead to vision rehabilitation therapies for TBI patients suffering from this dysfunction. Three subjects participated in a BOLD fMRI experiment comparing gaze and random vergence eye movements using a box car design. Preliminary data show activation in the precuneus, the cerebellar vermis, Brodmann areas 7, 9 & 10, middle temporal area (V5/MT), the supplemental motor area (SMA), the cingulate eye field, and the midbrain within the brainstem.

Irene Nwosuh, PhD Student in Applied Physics, "Development of A Highly Sensitive Personal Tonometer for Measuring Intraocular Pressure", (advised by Gordon Thomas), Easel 40

We have developed a highly sensitive trans-palpebral, personal tonometer that uses the compliance of the eyelid, and ocular medium (cornea and the eye's content) to determine intraocular pressure (eye pressure). This device will help glaucoma patients monitor their eye pressure without the assistance of medical personnel. It determines the eye pressure by plotting the force as a function of distance required to indent the eye through the eyelid. The analysis of the data we acquired indicates that the inverse slope of the linear regression of this force-distance graph corresponds to the combined compliance of the eyelid and the ocular medium. The ocular compliance which is inversely proportional to the eye pressure is determined in this method, by separating the compliance of the eyelid from the combined compliance of the eyelid and cornea. This procedure is based on the evidence of results of measurements that the eyelid and the globe are linear media (that obey Hooke's law).

Sean M. O'Malley, PhD Student in Applied Physics, "X-ray Diffraction Study of the Structural Phases within a Checkerboard Arrangement of ZnMnGaO₄ Nano-Rods on MgO (001)", (advised by Andrei Sirenko), Easel 43

The complex structural properties of epitaxially grown ZnMnGaO₄ thin films on single crystal MgO (001) substrates have been investigated using synchrotron radiation-based reciprocal space mapping (RSM). The ZnMnGaO₄ films consist of a self-assembled checkerboard (CB) structure of highly aligned and regularly spaced vertical nano-rods, driven by a strain accommodating interaction between Jahn-Teller active and inactive regions. Lattice parameters of the CB structure were analyzed using H-K, H-L, and K-L cross sectional reciprocal space mapping (RSM) around various symmetric and asymmetric reflections of the spinel structure. Analysis of the measured maps reveals a CB structure consisting of two perpendicularly oriented orthorhombic and two conversely twisted tetragonal domains with accommodating atomic displacements at the domain wall interfaces.

Silvana Ortiz, Junior Student in Chemical Engineering, "Evaluation of Polymeric Membranes for Separation of Biomolecules", (nominated by McNair Program, advisor Marino Xanthos), Easel 18

Fourth Annual Provost's Student Research Showcase

A membrane can be defined as a barrier film that restricts or facilitates the transport of various chemicals, including organic polymers, in a selective manner. Membranes help separate molecules and are extensively employed in filtration for drug sterility and other operations in the pharmaceutical industry. In this project I will first use simple fluids such as methanol, water, and their combination to evaluate the permeation characteristics of three types of polymeric membranes that differ in surface properties, pore size, and chemical resistance. The membranes are made of different materials and by different fabrication techniques. The relationship between pressure and permeation rate will be studied. Separation processes that will be used in this research are pressure-driven microfiltration and ultrafiltration. Findings from this first step with only pure liquids will be later on applied to the separation of biomolecules such as proteins.

Vivian Ozoka, Senior Student in Biomedical Engineering (with Bin Lin) , “Axon Stretch Growth Device for Real Time Imaging”, (nominated by McNair Program Mentor Angelo Perna, advisor Bryan Pfister), Easel 13

It has been postulated that axons are forced to increase in length during human development, implying that mechanical forces play a crucial role in axonal elongation. Moreover, once human development is complete, axons cease to grow. (Pfister et. Al) Therefore, a severed nerve could neither regenerate nor elongate by itself. The purpose of this project is to design a miniature version of preexisting axon stretch growth device that can stretch damaged axons in vitro to a length such that it can be implanted into the site of injured area to bridge the nerve gap. The device is small enough to sit on the stage of the microscope which allows the axons to be view while being stretched mechanically. The device will allow researchers and scientists to view and image the axon stretch growth process in real time underneath a high power microscope. As a result, the experimentalists will be able to analyze and investigate axon structure in great detail. Furthermore, scientists and researchers will be able to determine exactly which biological factors affect axon growth.

Ivan Padron, PhD Student in Physics, “A Fabry-Perot Interferometric Pressure Sensor with Alignment Tolerance and High Temperature Performance”, (advised by A.T. Fiory and N.M. Ravindra), Table 10

We will describe: A Fabry-Perot Interferometric Sensor (FPIS). It consists of a: Fabry-Perot cavity formed between two bonded surfaces; corrugated diaphragm with a center rigid body (or boss) which deflects under external pressure and keeps a high alignment tolerance.

Ku-Il Park, PhD Student in Material Science, “Modification of Polylactic Acid with Ionic Liquids”, (advised by Marino Xanthos), Table 12

In attempts to accelerate the degradation characteristics of polylactic acid (PLA) the addition of selected low MW ionic liquids (ILs), at concentration up to 5 wt%,

Fourth Annual Provost's Student Research Showcase

is shown to result in enhanced degradation rates depending on the anion structure, and accompanied by plasticization and lubrication. Hydrolytic and thermal degradation are studied via mass changes, gel-permeation chromatography, pH changes and visual observations. Lubrication and plasticization are related to melt viscosity and glass transition temperature measurements. Experiments are underway for soil degradation and understanding of the mechanisms involved in the presence of ILs.

Linda Plotnick, PhD Student in Information Systems, "Leadership in Partially Distributed Emergency Response Software Development Teams", (advised by Starr Roxanne Hiltz), Easel 34

Inter-organizational collaboration is becoming more common and when organizations collaborate they often do so in partially distributed teams (PDTs). A PDT is a hybrid team that has at least one colocated subteam and at least two subteams that are geographically distributed and communicate primarily by electronic media. Teams engaged in emergency preparation and response often have members drawn from multiple organizations, thus forming PDTs. This research focuses on PDTs engaging in software development for Emergency Response Information Systems. While PDTs share many characteristics with both traditionally colocated and fully distributed virtual teams, they also have unique characteristics and issues. The overarching research question for the study described in this poster presentation is, "Does leadership configuration have an impact on outcomes in PDTs and, if so, through what processes does it have this impact?". A model is proposed and a study, with preliminary results that suggest leadership configuration does have an impact, is presented. This research will contribute to the field by increasing understanding of leadership behavior and effectiveness in PDTs, particularly as they relate to the development of trust within and between subteams engaged in determining software requirements in the domain of Emergency Response Information Systems.

Gloria Portocarrero, Senior Student in Biomedical Engineering, "Mechanical Characterization of Electrospun Collagen Scaffolds for Cartilage Regeneration", (nominated by McNair Program, advisor Treena Arinzeh), Easel 27

Cartilage is the connective tissue located in different parts of the body like long bones and reduces the stress and friction on bones. The organic solid contains mostly collagen, which gives cartilage its strong tensile strength, and proteoglycan, which is strong in compression. Since collagen is the major organic component of cartilage, it is a good candidate for the major component of a scaffold that will cultivate cartilage cells. However, collagen alone does not possess the mechanical properties needed to provide proper cell growth. A solution to this is to crosslink the collagen with different agents that will change the material's mechanical properties. In this research project, collagen is electrospun with three different crosslinking agents. Electrospinning is a process that uses voltages to make mats with very fine fibers. The agents that are crosslinked are genipin, glutaraldehyde, and 1-ethyl 3-(3-

Fourth Annual Provost's Student Research Showcase

dimethylaminopropyl)carbodiimide (EDC). Tensile tests are performed using the Universal Materials Testing Machine or Instron. Results of the crosslinked collagen will be compared to the uncrosslinked collagen. It is expected that the crosslinked collagen will exhibit improved mechanical properties than the uncrosslinked collagen. With the additions made to the collagen, the crosslinked collagen would provide better mechanical strength for cartilage cell regeneration.

Filippo Posta, PhD Student in Applied Mathematics, "Signal Transmission in Epithelial Layers", (advised by Cyrill B. Muratov), Easel 36

Cell signaling is at the basis of many biological processes such as development, tissue repair, and homeostasis. This research focuses on the mathematical modeling of ligand mediated cell-to-cell signaling with particular attention toward the ability of the system to generate traveling fronts. Looking for traveling wave solutions in parabolic reaction-diffusion equations leads to elliptic problems in the traveling reference frame. This property is exploited with the generation of a novel numerical method (called Compensated Grids) for the solution of elliptic problems. This method is shown to be spectrally accurate when applied to two dimensional problems, and fourth order accurate in the three dimensional case.

Krit Punburananon, PhD Student in Environmental Engineering (with Ashish D. Borgaonkar), "Spectral Fluorescent Signature Post Processing by PCA-MLR Technique to Predict the Concentration of Six DOM Fractions in Water", (advised by Taha Marhaba), Easel 19

Total Organic Carbon (TOC) analysis is not only important in studying disinfection byproducts (DBPs) precursors, but also, it can help regulate the discharge of organic chemicals in to a water body. However, six dissolved organic matter (DOM) fraction concentrations is a better measure for understanding of the organic character of water than the TOC of water, which is an aggregate parameter typically used by water purveyors. The experimental procedure for TOC fractionation is lengthy and tedious; therefore, many attempts have been made towards development of faster and reliable techniques. Marhaba et al. (2000) built a model using multiple linear regression applied to spectral fluorescent signature (SFS) for predicting the six-fraction concentration in water. SFS by definition is a three dimensional matrix that records fluorescent intensity for a range of emission and excitation wavelength co-ordinates in a pre-selected spectral window. Fluorescence is a very sensitive technique and works best only at certain wavelengths that are different for different materials. It is therefore difficult to quantitate a material using fluorescence technique, especially when the entire fluorescence matrix is considered, no matter what statistical technique is used. Addressing this difficulty, this research is an attempt to build an enhanced model by combining Principal Components Analysis (PCA) with multiple linear regression. This new model first reduces the dimensionality of the input data by focusing on specific portion of the entire matrix that contains the peak locations for all six-fractions. This model provides better sensitivity and accuracy, while maintaining the advantages of the earlier model, such as: rapid identification and

Fourth Annual Provost's Student Research Showcase

quantification of DOM fractions. Potential use of the model is to determine the problematic organic character of source water (e.g., DBPs precursors) and to optimize water treatment processes.

Andrea K. Rodriguez, Sophomore Student in Industrial Engineering, "A comparison between waste management collection practices in an ancient metropolis and a suburban NJ town", (advised by Layek Abdel-Malek), Table 48

This is an NSF funded project which aims at investigating efficient ways of solid waste management. Operations research tools are utilized to develop environmentally conscious strategies for curb-side collection in the town of Millburn, NJ and an old section of Cairo Egypt. A comparison is drawn to show the effects of the various governing parameters and constraints on collection strategies for these two contrasting communities.

David E. Rodriguez, Senior Student in Computer Engineering and Applied Physics, "An Intelligent Planning and Maneuvering System for Autonomous Vehicles", (nominated by McNair Program, advisor Mengchu Zhou), Table 11

A system that provides a profile of feasible kinematical trajectories for an autonomous ground vehicle (AGV) is proposed. A substitute for common P.I.D. control of an AGV is introduced by learning and adapting its planning and execution based on the possible trajectories the vehicle can make. Data is extrapolated from the steering encoder, DGPS, and velocity sensors to train an artificial intelligence algorithm and create a tuned profile for the vehicle. Testing is performed on a 2001 Chevy Blazer fitted with motors for drive-by-wire capability. The autonomous trials performed by the test vehicle were very successful using this system providing accurate path following and planning based on a few manually driven trials needed to train the system. Further research into this system may allow an AGV to adapt to unknown environments and improve planning and handling while driving autonomously. Since this system provides specific profiles for each vehicle, it can be ported to different platforms/types of vehicles and complex maneuvers may be executed with ease. This system may also provide failure diagnostics due to wheel misalignment or a flat tire.

Ornthida Sae-Khow, PhD Student in Chemistry, "Carbon Nanotube Immobilization in Membrane Pores for Enhanced Separation", (nominated by Somenath Mitra), Table 2

We demonstrate that polyvinylidene fluoride/multiwalled carbon nanotubes (PVDF/MWNTs) can be readily immobilized into the pore structure of a polymeric membrane which can dramatically improve its performance. This was accomplished by injecting PVDF/MWNTs composite solution through a polypropylene hollow fiber under pressure. The nanocomposite were trapped and held within the pores and served as sorbents facilitating solute exchange from the donor to the acceptor phase. SEM and Raman measurement showed the presence and interaction of the nanocomposite with the membrane surface. The

Fourth Annual Provost's Student Research Showcase

effectiveness of this carbon nanocomposite mediated process was studied by micro-scale membrane extraction via direct solvent enrichment of organic solvent. The enrichment factor measured as the ratio of concentrations in the acceptor to the donor phases could be increased by 30-113%

Roger Saez, Junior Student in Chemical Engineering, "Effects of Temperature on the Release of Ethyl 4-Aminobenzoate from Ethylene Vinyl Acetate Membranes", (nominated by McNair Program, advisor Laurent Simon), Easel 30

Transdermal Drug Delivery Devices (TDDSs) offer several advantages over other dosage forms (e.g., oral, injection). They provide controlled release of a specified medicament to the patient and can dramatically reduce side effects associated with other delivery routes. The permeation rate is influenced by factors such as the type and thickness of the membrane and the system temperature. This study focuses on the effects of temperature on the delivery of Ethyl 4- Amino Benzoate (benzocaine) through Ethylene Vinyl Acetate (EVA) membranes. Different runs are performed using a range of temperatures (37o-43oC) in the donor chamber of a Franz diffusion cell system

Sudhakar Shet, Master Student in Electrical Engineering (with Gaurav Devrani), "Modeling of Magnetic Field Assisted Assembly", (advised by Ravindra Nuggehali), Table 46

Methods of magnetic field assisted assembly for the manufacture of semiconductor systems are summarized. Experimental techniques for the assembly process are described with examples. A two dimensional modeling scheme, using VIZIMAG, is developed for the magnetic field assembly process.

Sreeya Sreevatsa, PhD Student in Physics, "Control of Surface Chemistry by Electronic Structures", (advised by H. Grebel), Easel 17

We set to control ionic currents to and from a surface by adding a transistor-like structure in front of it. As an example, we examine the corrosion of metallic surfaces which are interfaced with alternate layers such as, *n-p-n* or *p-n-p*. The chemistry at an interface is dictated by the concentration of the ionic species and its potential distribution. One may provide with an ion-gating mechanism, maintained through electronic currents, by adding a permeable, multilayered semiconductive doped structure in front of the surface. Such construction may be useful for electronic control of various membrane functions as well as, study of ionic currents through such structures. In the past, passive protective films on iron have been extensively studied using potentiodynamic polarization measurements. We used this technique to carefully monitor the oxidation and reduction rate under biasing electronic currents. Imbedding microelectronic concepts in electrochemistry and biochemistry has been implemented mainly by two common concepts: 1. a gate potential is used to control ions in an isolated and inherently charged, nano-channel or, 2. ions in solution are affecting the gate potential of an otherwise pure electronic device (for example, Ion Selective Field-Effect Transistor, or, ISFET). In contrast, we propose here a different approach

Fourth Annual Provost's Student Research Showcase

whereby ionic current is driven *across* a (permeable) structure much like the BJT construction. The control over the ionic current is made by applying electronic current at the structure base electrode thus, changing the *electronic* band structure. Our membrane is made of functionalized Single wall Carbon Nanotubes (SWCNT) layers. By using polymers we achieved *p*- and *n*-type, mostly individual SWCNT. Thin films of functionalized SWCNT were successively deposited on a steel substrate. By alternating the film type we achieved either *p-n-p* or *n-p-n* complex. This multi-layered permeable structure was then introduced into an electrochemical cell. A typical cell has three electrodes: emitter (working), collector (counter) and reference electrodes. A biasing electrode is added to the middle layer of the permeable structure (say, the *n*-layer in a *p-n-p* structure) for ionic current control purposes. The entire element may be viewed as a common emitter (CE). Anodic reaction (corrosion) took place at the *p-n-p*/working electrode interface. Tafel plots, obtained through potentiodynamic measurements, showed that the *p-n-p* coated iron exhibited a much smaller corrosion current compared with its bare steel counterpart. As we were biasing the transistor-like structure, an interesting oscillatory behavior of the corrosion current was noted. *In summary*, we affected ionic currents by biasing transistor-like structures during corrosion experiments.

Demitrios Stamatis, PhD Student in Chemical Engineering, "Nanocomposite Powders as Burn Rate Modifiers", (advised by E. Dreizin), Easel 42

Aluminum powders have long been used in reactive materials for such applications as propellants, pyrotechnics and explosives. Aluminum has a high enthalpy of combustion but relatively low combustion rate. Addition of reactive nanocomposites can increase the burn rate of aluminum and thus the overall reaction rate. Replacing a small fraction of the fuel by a nanocomposite material can enhance the reaction rate with little change to the thermodynamic performance of the energetic formulation. This research showed the feasibility of the above concept using nanocomposite powders prepared by Arrested Reactive Milling (ARM), a scalable "top-down" technique for manufacturing reactive nanocomposite materials. The nanocomposite materials used in this study were 2B+Ti, and Al-rich 8Al+3CuO, and 8Al+MoO₃. The reactive nanocomposites were added to micron sized aluminum powder and the mixture was burned in a constant volume chamber. The combustion atmosphere was varied using oxygen, nitrogen, and methane. The resulting pressure traces were recorded and processed to compare different types and amounts of modifiers.

Gerardo Tolentino, Junior Student in Chemical Engineering, "The Influence of Donor Cell Concentration on the Delivery of Benzocaine through Ethylene Vinyl Acetate membranes", (nominated by McNair Program, advisor Laurent Simon), Easel 23

The manufacturing of efficient drug-delivery systems is a major challenge in the pharmaceutical industry. Design objectives can be partially achieved by controlling factors, such as drug solubility, loading dose and diffusion coefficient. By engineering a controlled-delivery system based on the drug concentration in

Fourth Annual Provost's Student Research Showcase

the vehicle, it is possible to customize a release device with a desired delivery rate. This study uses a two-chamber diffusion cell and focuses on the permeation of ethyl-4-aminobenzoate (benzocaine), a local anesthetic, through Ethylene-Vinyl Acetate (EVA) membranes. The drug, dissolved in a solution of PEG 400, was initially placed in the donor half-cell compartment. The receiver chamber contains a similar solution of PEG 400. Clamped between the two chambers is the EVA membrane maintained at a temperature of 37°C. The cumulative amount of drug in the receiver chamber was analyzed using a spectrophotometer. A higher concentration gradient across the membrane increases the steady-state transdermal flux in agreement with Fick's first law.

Daniel To, PhD Student in Chemical Engineering, "Environmentally Benign Deagglomeration and Mixing of Nanoparticles", (advised by Rajesh Dave), Table 6
Nanoparticles form very cohesive powders which are very difficult to mix and currently the most common methods use either organic solvents or surfactants which could be harmful to the environment. This study investigates the use of three environmentally benign and dry mixing methods and the role of deagglomeration in mixing.

Thomas H. Woodworth, Masters Student in Professional and Technical Communication, "Internal Communications as a Tool for Organizational Performance Improvement: Applying Theory to Practice in a Large Corporate Environment", (advised by Nancy Coppola), Table 9

Within large corporate organizations, many individual departments are faced with the practical challenge of communicating effectively with internal stakeholders. As today's corporations strive to adapt their processes to reflect customer-centric approaches to business, the field of corporate communications has emerged as an important resource for the organizational management to define and control organizational identity in the eyes of external customers. However, little attention has been given in the literature to exploring inter-departmental communications planning as a strategic activity. This presentation will introduce a novel process model for strategic inter-departmental communications planning in the corporate environment, and describe the recent real-world application of the model within the pharmaceutical industry. Key findings: 1) Although strategic corporate communications planning is generally understood to be the responsibility of an organization's upper management, it also offers a useful framework by which individual, non-management functions within an organization can improve inter-departmental relationships; 2) Appropriately applied, strategic inter-departmental communications planning can provide the impetus for organizational performance improvements with the potential to significantly impact external customer perception of an organization.

Caryn Yaacov, PhD Student in Joint Program in Urban Studies, "Dynamics of School Playground Use in Low-Income Neighborhoods: Four Case Studies from Newark, New Jersey", (advised by Maurie Cohen; nominated by Karen Franck), Easel 14

Fourth Annual Provost's Student Research Showcase

The strategy of rebuilding existing elementary school playgrounds in Newark's park-poor neighborhoods is deemed a particularly attractive solution to the current dearth of outdoor play areas: the space is readily available, designated, and managed. Given the often-impoverished quality of the supporting public infrastructure in which inner-city schools are sited, the question exists as to whether the mere existence of newly renovated school-managed playgrounds encourages active recreation. This study of four low-income neighborhoods in Newark explores the influences of neighborhood context, public school bureaucracy, municipal politics, and public-private interests on playground development and use. Research findings draw attention to the need to consider the larger social and political landscape in which playgrounds exist when formulating initiatives to encourage increased levels of physical activity among children.

Maria Beatriz Yabur, PhD Student in Urban Systems, "Noxious Odor in Residential Environments: Coping in Reactive and Proactive Ways in Three New Jersey Communities", (nominated by Karen Franck), Table 51

Noxious odors, which are endemic to many human activities, have grown more troublesome in urban environments as boundaries between land uses have become blurred in industrialized countries. Lack of land and the need for housing have pushed residential development into areas where industrial uses once predominated or, in rare cases, industrial uses have been located inside already existing residential communities. As a result, some residential neighborhoods are adjacent to odor producing facilities (e.g. slaughter houses, compost plants, waste water treatment plants). The odors that such establishments produce can be very annoying to residents and may also generate physical discomfort and health problems. Yet very little is known about the effects such "nuisance" odors have on people's lives. This study seeks to uncover some possible effects of current pockets of noxious odor in three New Jersey communities: West Caldwell, Newark's North Ward, and Jersey City. The odors are produced by a waste water treatment plant, a factory that dries yeast to manufacture vitamin e, and a wood recycling company that converts old pallets into shredded wood (mulch). The possible effects on residents include physical discomfort and actions undertaken to cope with the odor and its intrusion into daily life. With respect to coping, the study adopts two conceptual models: the reactive coping model (efforts residents make to avoid the odor) and the pro-active coping model (actions residents take to eliminate the source of odor).

Xiang Yao, PhD Student in Information Systems, "Exploring Benefits of Virtual Collaborative Scenario Creation for Emergency Preparedness", (advised by Murray Turoff), Table 7

The rapid economic, social, and political change after entering the 21st century necessitates continuous review and revision of emergency plans. Table-Top Exercise (TTX) is a classic planning and training technique that can be applied to achieve this goal. Currently, majority of the TTXs are still conducted in face-to-

Fourth Annual Provost's Student Research Showcase

face settings. This greatly constrains the applicability of this technique. Allowing players to participate in TTXs wherever they are and whenever they want can dramatically improve TTX's accessibility and flexibility, as well as saving costs and alleviating process losses related with face-to-face meetings. In addition, by introducing collaborative systems to manage information, the three major parts of TTX, preparation of scenarios, conduction of exercises, and debriefing of the results, can be integrated seamlessly. To design a specialized collaborative system for this purpose needs to address several challenges such as usability, information overload, and group awareness (GA). This paper introduces an experimental system called Collario (Collaborative Scenario) and how it solves these three challenges through utilizing metaphor, in-situation communication, and color-coding, as well how the collaboration processes of TTX are reengineered. Interview results with emergency management professionals show that the system is easy to learn and easy to use. Practitioners also comment that this system has potentials to overcome several problems in face-to-face TTXs. The interviews show promises of the system and virtual TTXs.

Yu Zhang, PhD Student in Mathematical Biology, "Using Recursive and Genetic Algorithms to Explore How Intrinsic Properties Affect Neurons' Activity Phase Following Inhibitory Input", (advised by Farzan Nadim), Easel 15

Bursting oscillations occur in many neurons and other cell types and underlie rhythmic activity in many networks of the central nervous system. The transient potassium A-current is present in most neurons and plays an important role in determining the onset of rhythmic activity. The prototypes of our research are the follower pyloric constrictor (PY) neurons in the rhythmically active crustacean pyloric network. We build a 3-variable model to examine the role of the A-current on the activity phase of a follower neuron in a rhythmic feed-forward inhibitory network. The precise influence of the A-current in setting the activity of neurons depends on its interaction with the inhibitory synaptic inputs and with other intrinsic properties of the neuron. By deriving recursive equations, we can calculate the extent of the available A-current over cycles and predict the activity phase of both the model neuron and the real PY neurons. By implementing a Genetic Algorithm search, we have built a multi-compartmental realistic model to simulate the real PY neurons and to verify the predictions of our recursive formulation.