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13th Annual Spring Symposium on Undergraduate Research Experiences (SURE)

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Bertrand H. Snell Hall Atrium
Rooms 112, 177, 212, 213, and 214

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An Evolutionary Valid Domain-Specific Risk-Taking Scale

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From an evolutionary perspective, human risk-taking behaviors should be viewed in relation to evolutionarily recurrent survival and reproductive problems. In response to recent calls for domain-specific measures of risk-taking, we emphasize the need of evolutionarily valid domains. We report on a recent study designed to validate a scale of risky behaviors in domains selected from research and theory in evolutionary psychology and biology, corresponding to reoccurring challenges in the ancestral environment. Behaviors were framed in situations which people would have some chance of encountering in modern times. Extending earlier work by Wang, Kruger & Wilke (2009), we collected risk item responses from 721 subjects. Our domains of risk-taking included between-group competition, within-group competition, status, environmental challenges, food selection, food acquisition, parent-offspring conflict, kinship, mate attraction, and short-term and long-term mating strategies.

Trends in Sexual Behaviors among Clarkson University Undergraduate Students

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Psychology

This study sought to understand Clarkson undergraduate sexual behaviors so the university can better serve students' sexual health. From 2005 to 2009, a survey focusing on sexual orientation, pregnancy rates, birth control usage, rates of vaginal, oral, and anal intercourse, average age at first vaginal intercourse, and number of sexual partners was administered to 556 undergraduate students. Results were compared to the comparative study (CS) from other colleges. Results: Participants identified as heterosexual (men, 96.1%; women, 87.8%), same gender (2.7%, 7.2%), or bisexual (1.2%, 5%). More Clarkson women self-identified as same-gender or bisexual than the CS. 4% had been a partner in an unintended pregnancy, significantly fewer than the CS. Most used birth control forms included the Pill (men, 46.2%; women, 61.3%), other hormonal methods (4.8%, 7.4%), male condoms (52.8%, 31.4%), female condoms (0.3%, 0%), spermicides (1.7%, 0%), diaphragms (0%), intrauterine devices (0%), withdrawal (9%, 7.4%), and natural family planning (0.3%, 0%). Clarkson women used the Pill and other hormonal methods as frequently as the CS, but remaining birth control methods were used less by all Clarkson participants. Rates for oral sex (men, 91.3%; women, 95.9%), vaginal intercourse (86.8%, 92.3%), and anal intercourse (32.4%, 32.1%) were higher than the CS. The average age at first vaginal intercourse was the same as the CS (men, 17.6; women, 17.2). Fewer Clarkson women had had one sexual partner (16%), and more women had had five or more sexual partners (50%) than the CS. These results suggest Clarkson students are more sexually active and diverse yet use less birth control.

Early Environment and Life-History Variables: Effects on Subsequent Risk-Perception and Behavior when going out for the Night

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Humans internalize environmental cues at an early age, which influences their subsequent risk-perception and risk-taking behavior. In the current study, we examined the effects of several life-history variables (such as age, sex, number and order of siblings, level of education) and early environmental factors on an individual's perception of risk in past and present environments. We designed an ecological survey to investigate which variables in an individual's living environment correlate to their current risk-taking behavior when going out for the night. We proposed that individuals who were exposed to high-risk environments in childhood would be less inclined toward risky behaviors than individuals who grew up in less dangerous areas. Participants provided three zip code locations, enabling us to compare the demographics of their past and current environments with their subjective ratings of risk/danger at each location.

Child Soldiers & the Girls and Women of Sierra Leone

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Humanities and Social Sciences

Sierra Leone's civil war begun in 1991 with the invasion of the country's border with Liberia; with the help of Charles Taylor, the Revolutionary United Front (RUF) a rebel group founded by Foday Sankoh, initially attacked small villages and gained momentum as they eventually dominated most of Sierra Leone. Foday Sankoh targeted young men who were frustrated with Sierra Leone's political and economic states. In addition the educational and health systems were also in poor condition.

Child soldiers were used because of the feasibility; children are perceived as innocent and harmless therefore the opposing side would not assume that the children were a threat. The pro-government forces would try to protect the children instead of thinking that they needed protection from the children. The creation of light weight weaponry also made the use of child soldiers more possible. Another contributing factor to the implementation of child soldiers was the "sense of alienation felt by many children" (Zack- Williams, 2001). They needed a community to belong to and the rebels provided it.

This project will also address the roles that women and girls played in the war in Sierra Leone. Women were often used as sex slaves and forced into marriage. To date, many "bush wives" are still with their husbands even though the war ended in 2002. It is important to examine how the children and women were helped (if at all) after the war, how they have adjusted to modern life, what could have been done to prevent their suffering and how to keep such a bloody war from recurring in Sierra Leone or anywhere else.

2014, Innovation& Entrepreneurship/ Political Science, Arete, CSTEP Dr. Chris Robinson & Dr. Stephen Bird

Experimental Methods for the Characterization of the Static and Dynamic Stability of a Spinning Body

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An active roll rate control system is being developed for spinning projectiles. The purpose of this project is to characterize the aerodynamics and stability of a blunt body spinning under conditions of roll rate decay. The aerodynamics of a model, given a low initial spin rate that is subsequently allowed to decay to zero, was examined in Clarkson's High Speed Wind Tunnel. Several different methods to spin the wind tunnel model and to apply an initial roll rate to the model were designed and tested, in order to find a solution which minimized friction roll damping and vibration. Techniques to accurately measure the roll rate have also been developed. The model was operated in vacuum to compare the roll decay rates and separate out the aerodynamic contributions from friction contributions to roll damping. From the aerodynamic data and the associated roll and decay rates the static stability of the model was estimated and its dynamic stability was predicted. These predictions will enable us to design a roll control system which will actively cancel an initial roll rate, allowing the vehicle to transition from spin stabilized to fin stabilized flight regimes.

2011, Aeronautical Engineering, Honors Program, Dr. Goodarz Ahmadi, Dr. Ratneshwar Jha, Dr. Piergiovanni Marzocca

Evaluation of Volatile Organic Compounds as an Indicator of Human Scent

Torey Jerauld
Robert Cully & Tara Beck
Institute for a Sustainable Environment

The concept of detecting humans by their individual odor has led to a growing body of research in the area of human odor or scent. The purpose of this research has been focused on the development of an electronic nose to detect trace levels of compounds that could be used as unique identifiers or biomarker of individuals. The first step of this study was to evaluate the sample collection and reproducibility of the VOC profile for individuals. Two techniques were used to examine the emissions of VOC from different body locations and compared to whole body VOC emissions: The glass funnel technique and the body envelope technique. The glass funnel sampling technique used a modified glass funnel to isolate a small patch of skin on the forearm and lower back in order to collect VOC emissions via SPME fiber. The body envelope sampling technique used a light weight coated chemical protective suit as a way to concentrate the VOCs in an envelope around the test subjects. In the case of both sampling techniques, the VOCs were collected using SPME and were then thermally desorbed and analyzed with a GC/MS. The preliminary data shows that the peaks in the VOC profiles are temperature related and show varied results when comparing samples collected in the summer versus those collected during winter months. This study is in the process of further analysis. Further study will provide a better understanding of the relationship between odor and peaks.

A Comparative Analysis of Natural Gas Drilling in New York and Pennsylvania

Neal Turkasz
Institute for a Sustainable Environment

Natural gas drilling in the Marcellus Shale region and throughout the nation is under attack due to the use of controversial practices and our country's growing energy demand for natural gas. Because of this growing demand the drilling companies need to use a process called hydraulic fracturing to maximize the output of the gas wells. The hydraulic fracturing process involves injecting a water, chemical, and sand mixture deep inside the wells in order to open fissures. Although the chemical mixture is recovered to some extent, it still has the ability to cause environmental damage especially in groundwater. With this knowledge in hand, the drilling companies may have overlooked some important environmental issues focusing mostly in New York and Pennsylvania. Some of these issues included the refusal to release the contents of hydraulic fracturing material composition information, moving drilling operations to a less environmentally controlled area, and the use of diesel fuel in the hydraulic fracturing process. All of the issues could not only harm the flora and fauna in the area but could also harm people in the region. The goal of this research was to systemically review the hydraulic fracturing processes and policies of the Marcellus Shale region and determine if it is potentially harmful to nearby residence of the region. Through careful analysis, I have determined that there is a considerable risk of negative environmental effects occurring with the use of hydraulic fracturing and current drilling policies should be altered or perhaps even created to better protect residence.

Determining the Feasibility of an Organic Based Food System

Camille Ricks
Institute for a Sustainable Environment

Given the rise of population and the need for new ways to nutritiously feed and sustain the growing population it is important to develop new and effective ways to manage the very little developable land left. This research project is important because in order for organic food to be competitive in the world market we need to determine if its current production and yields are comparable to that of conventional methods in terms of input and output yield gap. Overall we need to determine if organic crop production does or can result in a yield that stands up to the yields of conventionally produced crops while also being comparable to conventional crops in terms of inputs such as land use and labor and outputs such as crop yield. According to Catherine Badgley's research called "Can Organic Agriculture Feed the World?" the answer to this question is yes. However this is also a topic that is highly debated and has received much criticism. By examining and comparing several research studies on organic versus conventional agriculture this project seeks to congeal much of the information and available data in order to place some clarity into the debate once and for all.

Cookstoves: The World's Most Common Household Appliance: Evaluation of Particle Emissions

Christina Chapman
Institute for a Sustainable Environment

Approximately two billion people are routinely exposed to airborne particulate matter from the use of biofuels as their primary source of cooking food. The most common means of cooking is still an open or three stone fire, fueled by wood. Particulate matter produced from open, wood fires contributes to poor air quality, as well as respiratory health problems of occupants living in the often small, poorly ventilated dwellings. In addition to the impact on human health, deforestation and black carbon emissions from the fires have significant environmental impact. While a number of studies have measured particulate emissions from standardized or laboratory tests, adequate characterization of cookstove emissions has still not been documented. In an attempt to further observe the emissions, and understand the efficiency of the improved cookstoves, a series of tests were conducted. Ultrafine and $PM_{2.5}$ particle emissions from an improved stove were examined using a StoveTec GreenFire cookstove.. Particulate data was collected, using a Wide Range Particle Spectrometer™ Model 1000XP, using hardwoods and softwoods. Particle number and mass concentration, from the improved stove was analyzed and compared to that of a traditional three stone fire. While the manufacturer claims up to80% reduction in emissions, the data collected during these tests are closer to 50% reduction. If developing nations are aided in the design, construction and distribution of a reliable cookstove, a significant improvement in health, climate and deforestation will result.

2011, Chemical Engineering, Honors Program, Dr. Alan Rossner

Controlled Environment High Rise Farm P3 Project

Ethan Marsh & Gerlinde Wolf
Eileen Stachowski, Michael Guethle, Emily Collins, Gregory Jesanis & Sky McDonough
Civil and Environmental Engineering

Students at Clarkson University are in the process of completing the structure and functionality of a controlled environment high rise farm (CEHRF) on campus that will use the technology of aeroponics to grow plants years round. This project is being funded by the Environmental Protection Agency's award of a P3 grant which recognizes outstanding projects geared towards improving people, prosperity, and the planet. Aeroponics is a recent advancement in plant growth which allows plants to be grown without soil and with a mist being sprayed on their roots. This student project has been going on for several years and is now in the phase where lettuce and spinach plants are being grown inside of the greenhouse. The benefits of this type of project include providing food year round in cold climates, reducing water consumption, and eliminating (because of the lack of) soil erosion witnessed in typically farming practices. This technology has the potential to be a way for people living in cold climate to eat healthy, organic, and local food year round. Construction, determining optimal plant conditions, nutrient solution specification determination, and sensor design/installation are just a few of the engineering tasks being completed by students. By the end of the year a full scale design will be formulated in hopes of functioning as the guideline for similar structures to be implemented around the North Country.

Improving the Resolution of Nanoparticle Size Distribution Measurements of a DMA

Maria C. Lang
Dr. Suresh Dhaniyala
Mechanical Engineering

Recent studies and developments in aerosol instrumentation have focused on nanometer sized particles, as knowledge of their physical properties help determine the key roles nano-aerosols play in human health, such as their potential to cause respiratory and cardiac problems. A Differential Mobility Analyzer (DMA) is a critical instrument for classification of particle size distributions. The resolution of particle size distribution measurements with the DMA is dependent on the operating conditions of the instrument, in particular the sheath flow rate compared to the aerosol flow rate (the flow ratio). Accurate sizing characterization is crucial in aerosol research, and the DMA must be operated at higher flow ratios to enable high resolution measurements. However, the theoretical predictions of improved resolution at higher flow ratios are not realized for flow ratios greater than 10. To understand the underlying cause of this deviation, the flow field and electric fields inside the DMA have been analyzed using computational fluid dynamics (CFD). In addition, several diffusional particle trajectory and flow-uniformity calculations were performed to investigate the role of particle diffusion and non-uniform flow fields. Non-uniformity of the flow fields increases for higher flow ratios causing the lower-than-expected DMA resolution. Aerosol inlet design modifications were suggested that would be required to operate the DMA at high flow ratios to enable accurate particle size distribution measurements. Finally, the CFD simulation results of modified DMA inlet was verified with experiments. Accurate classification of nano-aerosol size distributions contributes to the study of anthropogenic activities and their effect on air quality.

Creating Artificial Cancellous Bone Micro Architecture using Stereolithography and a Ceramic Composite Photo Resin

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Dr. Laurel Kuxhaus[2] & Dr. Kathleen A. Issen[2]
Department of Chemical and Bimolecular Engineering[1]
Department of Mechanical and Aeronautical Engineering[2]

Understandingthe failure behavior of bones is paramount in order to reduce injuries and death related to osteoporosis. Mechanical testing of actual bone samples is challenging as every sample is unique, and is often destroyed in testing. To overcome this, microimaging allows a 3D,digital image, of bone samples and complex cancellous micro architecture to be generated non-invasively. The filecan then be used to create artificial physical models using stereolithography (SL) or other rapid prototyping processes.

Fine tuning SL resin to have mechanical properties similar to those of bone tissue could be the breakthrough to make these models relevant for this purpose. The focus of this research involves production of ceramic resins that offer higher mechanical properties for the solid object once cured. The ability of SL to create high resolution prototypes, combined with a bone tissue mimicking resin, can be used to produce complex microstructure samples with accuracy and precision of each subsequent sample produced. The ability of SL to produce models repeatably allows for more statistically relevant results when applied to this novel bone tissue study.

The research will be conducted in a semi-factorial design, with Young's modulus and Poisson's ratio as outcomes measures. The factors are the photopolymer material, the polymerization initiator, and the ceramic suspension for each of the resins, as well of the ratio of each of these materials to each other. The samples with higher concentrations of suspended hydroxyapatite particles are expected to have greater strength properties.

2011, B.S. Chemical Engineering, Chemical and Bimolecular Engineering, Dr. Sitaraman Krishnan

Microarchitectural Effects of Fracturing in Cervine Vertebral Bone

Kathleen Lewicki
Department of Mechanical and Aeronautical Engineering

The main goal of this project is to create a method to determine the relationship between microarchitecture and surface strains of vertebral bone which will stand as a base for further research for human vertebra. The proposed project will examine the effects of cervine vertebral bone microarchitecture on fracturing. The area of interest is the lumbar vertebra, specifically the fourth lumbar vertebra. Cervine lumbar vertebral bone has been determined to be mechanically similar to humans (Kumar et al., 2002). Currently in the United States, about 700,000 vertebral compression fractures occur annually, with a majority of the osteoporotic cases occurring in the lumbar region (Kim and Vaccaro, 2006). By compressing a three-segment lumbar vertebra in the load frame and using digital image correlation (DIC), surface strains of the vertebra will be able to be determined. Three-dimensional DIC (3D-DIC) will be used to account for the curvature of the vertebral bone so that entire vertebrae can be tested. The vertebra will also be scanned using a micro computer tomography (microCT) scanner, which allows the microarchitecture of the vertebral bone to be examined. The vertebra will be scanned before and after compression loading to determine which microarchitectural structures failed and if they can be related to the surface strain determined from compression loading and DIC. It is hypothesized that the orientation and geometric parameters of the microarchitecture will determine the site of fracture.

Feasibility of a Regenerative Braking System for a School Bus

Gabrielle String
Department of Mechanical and Aeronautical Engineering

A regenerative braking system (RBS) is proposed to improve the fuel efficiency of a school bus and reduce the exposure of children to diesel particulates. The primary benefit of a RBS is a decrease in the amount of fuel used to drive the bus, however an additional advantage could also be a reduction in the exposure of school children to diesel emissions. A RBS captures and stores the energy, typically lost to heat through friction during braking, and then uses this stored energy to accelerate the vehicle forward. It has been determined that the most efficient RBS for large vehicles is one that uses hydraulic fluid and a mechanical device to store the energy. The ADvanced VehIcle SimulatOR (ADVISOR) from the National Renewable Energy Labs is being used to model the drive cycles of the school bus. Previous studies from an EPA partnership with the Eaton Power Corporation have shown up to a 65% fuel savings. Data on braking and acceleration energies from ADVISOR and information from the Potsdam School District is used to design a hydraulic RBS prototype system for a bench scale set up. Tests are conducted and analyzed in lab to draw conclusions about the feasibility of this system.

2011, Mechanical Engineering, Honors Program, Dr. Kenneth Visser

Impact of Historic District Designation on Housing Prices

Jason J. Altieri
Dr. Martin Heintzelman
School of Business/Honors Program

We examine the impact that local historic district designation has on the prices of homes both in and near a district. Our data consists of home sales and historic districts within the greater Boston-Quincy-Cambridge metropolitan area. We use census block and property level fixed effect regressions to evaluate the effects of designation on prices. Census block level fixed effects suggest that historic districts positively impact sales price both for houses in a district and those in close proximity. On the other hand, the property level fixed effects imply that there is a negative price impact on houses located within a district and no statistically significant result on homes in close proximity. The differing results show that the property level fixed effect model not only gives us a better estimate of the true impact of historic districts on home prices, but it highlights the methodological problems that exist within the census block level fixed effect model and several past studies in this area.

Level Playing Field?
Participation in Collegiate Varsity Athletics and its Effect on Early Career Success

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School of Business, Organizational Studies

This research examines how participation in collegiate varsity athletics affects overall career success after college. Based on theory in mentoring, organizational commitment, and emotional intelligence, we predicted that student-athletes would develop greater teamwork and relationship management skills, leading to higher starting salaries as they enter the professional workforce and faster rates of salary growth as their careers progress. In a cross-sectional nationwide study, we find that former student-athletes score higher on measures of mentoring reception, mentoring others, organizational commitment, and emotional intelligence and have higher salaries through the first ten years of their careers than their non-athlete counterparts. We also find that there are significant interaction effects for gender, such that male-student athletes score higher than male non-athletes on mentoring reception, mentoring others, and emotional intelligence, while female student-athletes and female non-athletes score the same. Results show that the salaries of athletes and non-athletes were noticeably different for males and females. We discuss the implications of these results for both theory and practice.

2011, Interdisciplinary Engineering & Management, Honors Program,
Dr. Stephen Sauer and Dr. Martin Heintzelman

A Multi – Method, Spatial Approach for Explaining the Appearance and Passage of Community Preservation Act Referenda

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Honors Program

To guard against urban sprawl, many communities in the United States have begun enacting policies to preserve open space, often through local voter referenda. Massachusetts sponsors such municipal action with the Community Preservation Act (CPA) by providing matching funds to towns that, through a referendum, choose to enact a property tax surcharge of up to 3%. These towns spend the money raised (including matching funds) on open space and historic site preservation, and/or the provision of affordable housing. Understanding which factors contribute to the appearance and success of such measures is important for policy makers and conservation advocates alike. This holds true not only in Massachusetts, but across the United States as well. Previous literature has studied these causative factors in detail; however, this is the first study to account for spatial dependence and spatial autocorrelation. A comprehensive dataset describing all 351 Massachusetts municipalities was constructed for our analysis, which includes a variety of demographic, economic, geographic, and open space variable vectors. We begin by utilizing a non-spatial approach, which employs a discrete choice model (a probit regression in our case) to estimate the appearance of CPA referenda, and a weighted least squares regression to estimate the passage of CPA referenda. We extend this analysis by using a Stratified Cox – Proportional Hazard Model to estimate parameters surrounding the timing of CPA passage. Finally, we use spatial econometric approaches to account for the geographic relationships that exist between our data observations.

Novel Nanocomposite Materials for Solar Cell Fabrication

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Lalitha V.N.R. Ganapatibhotla [2], Xinli Jia[3], Dr John McLaughlin[4]&
Dr. Sitaraman Krishnan[5]
Department of Chemical Engineering

Dye-sensitized solar cells (DSSCs) have garnered interest recently since they present a relatively low cost means of energy generation. Single wall CNTs, used as conducting scaffolds in a TiO2 based cell, were capable of doubling the photoconversion efficiency of a photo-electrochemical cell. The work proposed here aims at developing *solid-state dye-sensitized solar cells using TiO2/CNT/ polymer nanocomposites.*

The focus of this research is to:

- Increase the power conversion efficiency and the overall performance characteristics of dye sensitized solar cells (DSSCs) through the development of novel polymer-titania nanocomposities.
- Improve conventional TiO_2 DSSCs by employing blends of carbon nanotubes (SWCNTs) with novel polymer electrolytes.
- Develop a model to characterize the interfacial behavior at the nanotube polymer surface.

The modeling to be performed is based on the Scheutjens-Fleer Method. This method is based on the Flory Cell Model of Polymers. The method can be used to obtained detailed information about the composition, surface energy, and structure of polymer films. Thus far, work is being carried out using the Scheutjers-Fleer Model to:

- Develop a program that can be used to model stiff polymer chains that adsorb onto a cylindrical surface.
- Use the program to obtain detailed information about the surface energies and the conformation of chains that are adsorbed onto a carbon nanotube that will be treated as an infinitely long cylinder.

[1]Class of 2011, Chemical Engineering, McNair/CSTEP, Honors Program, Dr. John McLaughlin

The Capping of Nanoporous Materials for the Preparation of Fluorescent Biomarkers and Smart Drug Delivery Systems

Jennifer Sidletsky
Chemistry & Biomolecular Science

Effective cancer treatment relies on novel imaging and drug delivery systems supported by evolving technology. One improvement is the nanoparticle system, which protects a compound from metabolic degradation that occurs during circulation as well as preventing the high levels of systemic action that adversely affect the body and cause many deleterious side effects. Through functionalization of the particles, a targeted delivery system can be made, based on the chemical affinity of the cancerous cells for certain functional groups and molecules.

Nanoparticulate contrast agents greatly improve the sensitivity of imaging and allow for visualization of maladies before symptoms occur, allowing for the development of targeted and efficient treatment plans. Similarly, the effectiveness of drug treatment is greatly improved by incorporation of the drug into nanoparticles. In this study, mesoporous silica as both an imaging agent carrier and a drug delivery system were investigated.

Dye-loaded particles were previously capped permanently for an imaging contrast agent and the optimal capping system was achieved for minimal leaching of dye from the particles. Another novel permanent capping system involved unsaturated surfactant synthesis, dye-containing silica particle synthesis from the surfactant, and initiation of radical cross-linking of the surfactant for permanent capping of the particle. Leaching trials to test the efficacy of this capping system were conducted. The third phase of the project involved synthesizing particles, loading them with dye to simulate a drug, and forming a biodegradable cap sensitive to reductive atmospheres, such as those found in hypoxic tumors. Future work includes further generation and testing of these particles.

A Comparative Analysis of Waste Conversion into Oil

Dustin Nuhfer
Dr. Richard Partch
Chemical Engineering

The progression of two recent issues: rapid landfill growth and high fuel costs, has stimulated the search for economically viable methods of extracting energy from waste. Previous research by the U.S. Bureau of Mines and by the Partch research group at Clarkson University has demonstrated that biomass from wastewater treatment plants and other organic based sources may be converted into oil through reaction with carbon monoxide in water. This simultaneous reduction of residual waste volume and production of fuel has also been shown to occur for waste sludge when reacted in the presence of aqueous sodium formate. To determine the effectiveness of less energy intensive reaction conditions, the present investigations explored oil production under lower reaction temperatures and pressures. Reactant ratios, simultaneous reactions, and gold catalysis were studied to determine their effects on oil production. In this work, sodium formate in water was reacted with sugar, coffee grounds, mattress foam, milk jugs, leaves, human hair, and others at 320°C ± 20°C and 1000 - 2000 psi, all yielding low amounts of desired product under the moderate reaction conditions. The oil was extracted and then analyzed using infrared and nuclear magnetic resonance spectroscopy, which indicated possible oil production. Sugar was then utilized as the compound for which alternative variables were investigated. The effects of bubbling carbon monoxide into water for 10 and 20 minutes, use of sodium formate and tetramethylammonium formate, and the addition of gold nanoparticles as catalyst were explored. These results serve as reference information for comparison with oil production using higher temperatures and pressures in future work.

Deposition of Semiconductors on Metallic Substrates

Matthew Souva
Dr. Ian Suni
Department of Chemical and Biomolecular Engineering

Electroless deposition of semiconductor materials onto aluminum substrates is presented. Efforts involve use of varying silicon and germanium salts in aqueous and organic solvents. By depositing through spontaneous electrochemical means, no additional voltage is applied. Cyclic voltammetry is used to study the electrochemistry of the semiconductors in solution and scanning electron microscopy aides in the characterization of deposits. Semiconductor deposition holds application in use for thin-film photovoltaics. This research and presentation is done in completion of an honors thesis.

Synthesis of Polyacetylene from Unconventional Precursors for Application in Photovoltaic Devices

Patrick R. Kelleher
Chemical and Biomolecular Engineering

Iodine-doped uniaxially oriented polymer films are known for their interesting optical properties such as the polarization of visible light. Recently, there has been interest in the photovoltaic properties of oriented, iodine containing, organic thin films. The current research is an investigation of mechanically stretch oriented poly(vinyl alcohol) thin films. The films were reacted with hydriodic acid (HI) vapors at 150 to 300 °C to form polyacetylene. The reacted films were investigated using Fourier transform infrared spectroscopy (FTIR) and X-ray photoelectron spectroscopy (XPS). Polarization characterization was performed using UV/Vis spectroscopy. After thermal annealing, differences in the absorbance of polarized light in orientations parallel and perpendicular to the stretch directions indicated that the polymer chains were aligned along the stretch axis. Significant differences in the FTIR spectra of the pre- and post-annealed films provided evidence that the annealed films were partially dehydrated, and that conjugated polyacetylene segments were formed. The XPS survey scans and high resolution C 1s spectra were used to correlate the extent of dehydration to the reaction temperature, concentrations of HI and iodine in the films, and reaction duration. These films are expected to find application in photovoltaic devices, including different types of polymeric solar cells.

Microwave Curing of Alkali Activated Fly Ash Mortars

Jeevaka Somaratna
Department of Civil and Environment Engineering

Cement production is a very energy intensive process. Every ton of cement produced emits one ton of carbon dioxide to the atmosphere. In an effort to reduce carbon emissions from the concrete industry cement is being partially replaced by waste products such as fly ash, ground granulated blast furnace slag and silica fume. Research is underway for complete replacement of cement by these supplementary cementitious materials and as a result of these efforts cement-free binders (CFB) have been developed. For desirable material properties to be achieved fly ash CFB's need to be heat cured at 75°C for 48 hours. In the study conducted the possibility of microwave curing of alkali activated CFB mortars was explored. Mortars with 50% paste volume having an activator-to-binder ratio of 0.4 was made with NaOH activated class F fly ash as the binder. After choosing microwave curing parameters (power level, duration) to negate thermal runaway microwave curing of 120 minutes resulted in strength development greater or comparable to CFB mortars that were heat cured. The energy absorption of the mortar specimens depends on its dielectric properties. The energy absorption rate is initially observed to be constant up to 75min of microwave curing. This is due to the coupled effect of drop in the dielectric loss factor owing to moisture loss and the increase of the internal electric field. The compressive strength development is seen to be related to the microwave energy supplied when free water is present in the system.

Class of 2012, Double major in Civil and Mechanical Engineering, Honors Program,
Dr. Narayanan Neithalath

Implications of Powerline Corridor Vegetation Management for Golden-winged Warbler Habitat

John Wojcikiewicz
Biology

My research focuses on the conservation of the Golden-winged Warbler, a shrub-land bird that in recent decades has experienced dramatic population declines in the Northeastern U.S. Habitat loss as a result of changes in land use patterns and reforestation, as well as competition from the closely related Blue-winged Warbler have been the major factors contributing to the decline of the Golden-winged Warbler. Due to the rather specific habitat requirements of these birds, greater efforts have been made to make the most of all available sources of habitat for the species.

It has been found that the managed shrub-scrub vegetation found along powerline corridors is one potential source of habitat for the Golden-winged Warbler. The study I performed over the summer of 2010 assessed the occurrence of Golden-winged Warblers, Blue-winged Warblers, and the hybrid Brewster's Warbler along powerline corridors throughout Upstate NY. Powerline corridor vegetation is managed to prevent the growth of trees and large shrubs from interfering with the powerlines. To manage the vegetation, utility companies often employ either chemical (herbicides) or mechanical (tree cutting/brush clearing) techniques. While both techniques are used to achieve a similar goal, how each technique differently effects the habitat quality of the Golden-winged Warbler has not previously been assessed.

The purpose of my current study is to compare the two powerline corridor vegetation management techniques (chemical and mechanical), and to assess how each technique effects the quality of Golden-winged Warbler habitat. By learning the management technique employed at each location that a Golden-winged Warbler was previously found from the summer 2010 study, an understanding of which management technique produces the most desirable habitat for the Golden-winged Warbler can be achieved.

The Effect of HPV-16 on the Expression of Toll-like Receptors and Defensins

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Dr. Craig Woodworth
Department of Biology, Clarkson University

Human Papillomavirus-16 (HPV-16) infection is known to be necessary for cervical cancer development, especially when HPV-16 is able to avoid the immune response and persist in cervical cells for a long period of time. We hypothesized that the expression of two families of innate immune proteins, the toll-like receptors (TLRs) and the defensins, would be down-regulated in immortal or tumor cell lines infected with HPV-16, and, thus, may give HPV-16 –infected cells a survival advantage. Cells of varying stages of malignant progression were cultured to confluence and their RNA was extracted and purified. We used reverse transcription to obtain cDNA, and qRT-PCR to quantify the expression levels. All genes of interest were normalized to a minimum of two housekeeping genes and analyzed using Minitab Statistical software. We observed that the expression of four beta-defensins (HBD-1, HBD-2, HBD-3, HBD-5), HBD-5) was significantly decreased in immortal cell line mRNA compared to that of normal cell strains. We also noted that the expression of the TLRs RNA examined in immortal cells was also decreased, but not significantly. Tumor cell expression of beta-defensins and TLRs was more variable. Despite promising beta-defensin results, no statistically significant differences were seen the alpha-defensins tested. These findings suggest that HPV-16 manipulates expression of some beta-defensins, possibly in order to increase the virus's own chance of survival. More specific mechanisms are currently being investigated, as well as HPV-16's ability to inhibit induction of TLRs and defensins.

Effect of NF-kB on HPV-16 Upstream Regulatory Region Expression in Normal Cervical and Foreskin Cells

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Department of Biology

NF-kB is part of a family of transcription factors involved in activating the inflammatory response. A functional binding site for NF-kB has been located on the upstream regulatory region (URR) of the HPV-16 genome. This site is thought to allow NF-kB to inhibit HPV gene expression. We hypothesize that overexpression p65 will inhibit HPV gene expression and inhibition of NF-kB using an IkBa dominant negative mutant (DNM) will increase HPV expression.

To study this question, cervical and foreskin cells were transiently cotransfected with a URR reporter gene or NF-kB reporter gene, renilla, and experimental DNA (p65, IkBa DNM, or LZRS control vector). We found that p65 downregulates the HPV-16 URR in the majority of cell strains. In cells transfected with the NF-kB reporter gene, the expected result of upregulation with p65 treatment was seen. However, due to low activation levels of NF-kB in the cells, a large inhibitory effect from IkBa was not seen. Due to this, experiments using 12-hour TNFalpha treatments, an activator of the NF-kB pathway, are in progress.

NF-kB has become an attractive therapeutic target because current evidence suggests that it is involved in the development of inflammatory diseases. However, our results suggest that caution is warranted. If NF-kB inhibition leads to upregulation of HPV gene expression, this treatment might also increase the risk of cervical cancer.

Testing of Possible Relationships between Ecological Variables and the Evolution of Viviparity in *Liolaemus* Lizards

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Department of Biology

The present research investigated the relationship between ecological variables and the evolution of viviparity (live birth) in a species rich group of South American lizards in the genus *Liolaemus*. Variables such as elevation and altitude, widely researched in the context of reproductive mode, were interpreted according to the current knowledge of viviparity to test traditional hypotheses of their association. Specifically, we tested the cold-climate hypothesis, which states viviparity is more likely to evolve in colder temperatures. The goals of the present research were to identify if a relationship exists and possible evolutionary directionality between ecological variables and viviparity. We applied a novel model of evolution that uses statistical methods of phylogenetic logistic regression for a binary dependent variable used when the dependent variables are non-independent among species (Ives and Garland, 2010). This model takes into account phylogenetic correlation between species, addressing the limitations of standard logistic methods, which do not account for relatedness and are more likely to inflate type I errors. Our results strongly support a relationship between altitude and species that have evolved viviparity but there was no support for viviparity associated with taxa living at higher latitudes.

Clarkson University Trail Network Impact Assessment and Management Plan

Katlin Wenzel
Environmental Science & Policy

Demand for recreational land use has increased greatly in the last decade, along with increasing population size, higher standards of living and more leisure time. Long-term recreational use of trail networks has been proven to alter soil and vegetation, causing issues such as soil erosion, compaction, trampling and introduction of invasive species. This study was designed to provide an impact assessment on the approximately 2.1 kilometer long recreational trail system located behind the Clarkson University campus in order to determine the extent of user damage present on this trail system. By analyzing data regarding the types and magnitude of impacts, proactive and financially feasible management actions could be identified and implemented that would improve recreational experiences and maintain the natural resources of the area. Analysis included transect-based impact assessment as well as use of game style motion cameras to survey type and density of trail usage. Following this assessment, this study established management techniques in order to halt existing impact, restore heavily impacted sections of trail, and prevent future impact of the trail network to the furthest degree plausible. Optimally, this study will be able to act as a benchmark for future management action, as well as a guide to outlining the most appropriate actions to steward this resource.

Poecile Atricapillus and *Sitta Carolinensis* Behavior to *Cyanocitta Cristata* Calls at Clarkson University

Joshua Felch and Simone Lee
Biology

Many factors have an affect on the decision making process in animals. This particular research investtigates how certain factors affect an individual's choice to feed in the open. *Cyanocitta cristata* (Eastern Blue Jays) are relatively large birds that are often found to be aggressive towards other birds. *Poecile atricapillus* (Black-Capped Chickadees) and the *Sitta carolinensis* (White-Breasted Nuthatches) are significantly smaller than Blue Jays but, are often found in the same regions, and can feed on the same food. For this reason they were considered to be a good model to see how the threat of attack affects decision making. This study examines the hypothesis that a risk of interruption affects how often Chickadees and Nuthatches decide to land on a feeder and the duration of time that they spend gathering seeds. We predicted that a more aggressive sounding call would cause the birds to come less often and stay for a shorter amount of time. There were four Blue Jay calls used, varying in intensity, the forth call was a time of silence. The seeds were dispersed within sand so the birds had to land and pick out the seeds. The calls were started after the landing of the first bird and all 4 of the sounds were played. All of their behaviors on the feeder were videotaped. We found that the Chickadees and the Nuthatches came less often when the calls were aggressive but the duration of the stay did not change.

Development and Characterization of a Functionalized Permselective PPD-Membrane Electrode for the Determination of Superoxide Radicals

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Department of Chemistry and Biomolecular Science
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Reactive oxygen species (ROS) are generated naturally through the metabolic process; these species are detrimental to DNA, proteins, and other biological structures. Various natural and synthetic agents, known as antioxidants, are capable of curtailing the ROS damage by scavenging the free radicals through a reduction process. Traditionally, the scavenging capacity of an antioxidant is detected by UV-VIS spectrophotometry with 2,2'-azino-bis(3-ethylbenzthiazoline-6-sulphonic acid) (ABTS) and potassium persulfate. Electrochemical sensors can be used as an alternative method for the detection of ROS and antioxidant capacity; the advantage of electrochemical methods is the fast response time and the high sensitivity. A platinum-based electrode functionalized with a permselective PPD (poly-*ortho*-phenylenediamine) membrane was developed in this work as an electrochemical sensor for the determination of antioxidant capacity. This was accomplished by using an enzymatic system involving hypoxanthine (HX) and xanthine oxidase (XOD) capable of generating superoxide radicals ($O_2^{\bullet -}$), and by the spontaneous dismutation of superoxide to hydrogen peroxide. The radicals were monitored at +700 mV *vs*. Ag/AgCl reference electrode; the use of a highly selective PPD layer removes many of the common interferences that could occur due to the nonspecific oxidation of co-existing oxidizable molecules. The stability of the membrane and electrode was studied, and used to screen compounds for possible antioxidant activity.

2011, Dual Chemistry and Biomolecular Science, Senior Thesis/NSF-IRES, Dr. Silvana Andreescu

Identification of Serum Protein Biomarkers for Autism Spectrum Disorder

Melissa Butkiewicz
Dr. Costel C. Darie
Department of Chemistry and Biomolecular Science

Autism spectrum disorder (ASD) is a developmental disorder with no known etiology. In the United States one in 150 children are diagnosed with ASD, making ASD as prevalent as Alzheimer's disease. Identification of ASD in a child is usually performed by a child psychologist. However, so far, there are no biochemical means to identify ASD in the early stages of children. Therefore, using serum biomarkers for early detection of ASD in children will help diagnosis of ASD in its early stages, when behavioral therapy may help treat ASD. Identification of ASD serum biomarkers could be done with common proteomic analyses. In our study, we used gel electrophoresis and mass spectrometry in a proteomics approach to identify serum biomarkers in ASD that will hopefully lead to increased early diagnosis of ASD through biochemical approaches and point to additional causes of ASD.

Based on previous ASD research, it has been shown that there are differences in the protein patterns in the serum samples from patients with ASD, compared with the control samples. It has also been found that these proteins correlate between different serum samples from ASD patients [8]. With the combination of two dimensional gel electrophoresis (BN-PAGE and SDS-PAGE) and mass spectrometry in a proteomics approach, it is possible to identify proteins that are potential serum biomarkers for ASD.

Biomarker Discovery through the use of Proteomics Tools

Rama Yakubu
Supriya Mathur, Izabela Sokolowska, & Dr. Costel Darie
Biomolecular Science & Chemistry

Serum biomarkers are proteins or peptides that either appear in or disappear from the sera of people with a particular disease, compared with serum from normal subjects. The area of proteomics, which is the study of protein structure and function, has provided useful tools for the detection of such serum biomarkers. The discovery of new serum biomarkers could help to establish an early warning system, which could decrease the deaths due to cancer through prognosis and proper diagnosis in early stages of the disease. Serum biomarkers are usually identified by proteomics experiments, which involves sample preparation (e.g. electrophoresis), mass spectrometry measurements and data analysis. Here we used SDS-PAGE in non-reducing (NR, SDS-PAGE NR) conditions as a primary sample preparation tool to search for protein biomarkers in the human serum samples of patients with prostate cancer and in healthy subjects. Novel to our approach of biomarker discovery is the analysis of serum biomarkers in SDS-PAGE non-reducing conditions, which leaves existing disulfide bonds between cysteine residues of the same or other proteins intact. Combination of SDS-PAGE (NR) with mass spectrometry and data analysis allowed us to identify a set of proteins that are potential serum biomarkers. Our current efforts are focused on further search for additional serum biomarkers and validation of the ones that were already identified.

Reconstructable Polymer Brush as a Substrate for Stem Cell Culture

Kenneth G Yancey
Dr. Sergiy Minko
Chemistry

The critical need for better grafting technology is clear from the fact that approximately 110,000 people are waiting for transplants and only 1 in 4 receive an organ in time to save their life. Tissue engineering (TE) potentially produces tissue grafts from the patient's cells which are 100% biocompatible. However, if TE is to develop the flexibility and control over cellular development needed to solve the issues of immune rejection and scarcity, a selectable cellular attachment substrate with growth factors is needed. This research involves the development of a thermally sensitive bipolymer brush of amino terminated poly(ethylene oxide-b-acrylic acid) copolymer (PEO) and dicarboxy poly(N-isopropylacrylamide) (PNIPAM) for the culturing and selective attachment of mammalian cells. By exploiting PNIPAM which exhibits a conversion from hydrophilic to phobic states at physiological temperatures, we believe that these states can be exploited to allow for the selective delivery of growth factors. This delivery of growth factors is expected to stimulate protein attachment and cellular adhesion when PNIPAM is in the hydrophilic extended state. When temperature is increased and PNIPAM is hydrophobic and collapsed, these growth factors will be shielded and won’t bind protein. Any surface which could selectively bind protein or detach cells leaving them physiologically normal is of immense benefit to numerous fields of study.

Generation of Silver Nanoparticles from Reduction of Silver Phosphate

Russell Davis
Dr. Ionel Halaciuga & Dr. Dan Goia
Chemistry and Biomolecular Science

A great deal of experimentation has been done using silver nitrate as a source for zero valent silver nanoparticles. Unfortunately, there is only limited understanding of the mechanisms by which nanoparticles are generated and a correspondingly limited ability to generate particles with specifically desired characteristics. Because of this, it is possible that use of other sources for silver nanoparticles can be advantageous both because of the potential for scientific advancement and because of potential industrial applications if other sources prove to be viable. Preliminary efforts were made to characterize the generation of silver phosphate using silver nitrate and sodium hydrogen phosphate in the presence of a dispersant using double-jet addition of each reactant to deionized water. The silver phosphate particles were then reduced using hydrazine and isoascorbic acid to generate silver nanoparticles. Silver phosphate particles were effectively generated in an aqueous solution using $AgNO_3$ and $Na_2HPO_4 \bullet 7\ H_2O$. These particles were then be reduced using hydrazine hydrate or isoascorbic acid to generate zero valent silver particles under a variety of conditions in order to determine the effect of reaction conditions on particles generated. Additionally, the nature of the silver phosphate particles generated was found to be of interest, and has merited further study.

Characteristic Length Scale of Microstructures in Pharmaceutical Compacts

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An ultrasonic technique for the microstructure size characterization of solid dosage pharmaceutical tablets is presented. The technique is based on the relationship between the attenuation of longitudinal ultrasonic elastic waves and the microstructure size distribution of the tablet material. In the reported experiments, the ultrasonic attenuation in lactose monohydrate (LMH) pharmaceutical compacts is measured by means of two pitch-catch experiments. The frequency dependent attenuation coefficient for the LMH compacts is then related to the microstructure size distribution. For verification purposes, the microstructure size distribution of the LMH compacts was also established using Microscale X-ray computerized tomography (MicroXCT). The size distributions obtained by both methods agree well, demonstrating a consistent mean characteristic length scale size, size range and overall distribution trend. The microstructure of a pharmaceutical compact (i.e., characteristic length scales and micro-feature size distribution) has been shown to have a profound effect on its mechanical properties, namely hardness, porosity, and mass density distribution, and in turn, can critically impact the dissolution profile and structural integrity of a compact. The ultrasonic technique presented provides a non-destructive and rapid method for determining the characteristic length scale distribution of powder compacts, thus providing a more timely and cost-effective method, compared to traditional techniques, of characterizing a compact's internal microstructure.

Class of 2011, Dept. of Chemical and Biomolecular Engineering, Honors Program/Dept. of Mechanical and Aeronautical Engineering, Advisor: Dr. Cetin Cetinkaya

Rotor Optimization for Diffuser Augmented Wind Turbines

Devon Jedamski
Department of Mechanical & Aeronautical Engineering

A Diffuser Augmented Wind Turbine (DAWT) utilizes an expanding duct to increase the mass flow through the rotors of a turbine. Diffusers augmentation for wind turbines is a relatively young technology and to date, no commercially viable design has been successful on the market. Experimental data is currently being collected at the Clarkson University Wind Turbine Test Site to examine the characteristics of a DAWT designed by the WindTamer Corporation. A numerical and experimental study is being conducted to further optimize the rotor in the presence of the diffuser to increase the power output while keeping production costs at a minimum. Collected data, including ambient conditions, power output, and other information, will be used to suggest further alterations, and to provide reliable long-term based product data. Current work includes adapting mRotor, a blade element momentum code used for rotor analysis developed at Clarkson University, to design a more efficient rotor specifically optimized for use in a DAWT. The design will then be experimentally tested to confirm the numerical results.

Experimental Characterization of Lithium Polymer Battery Charging Cycles during Bilateral Energy Exchange in Power-Autonomous Systems

Pushpak Jha
Electrical Engineering

The goal of this research is to investigate lithium polymer batteries to better understand their capabilities, characteristics and limits. Lithium polymer batteries are widely used, especially in the hobby industry, but there is not much literature available on their performance. Of particular importance is the life time of the battery, battery capacity fade and the efficiency of recharging. Specifically we will investigate how efficiently the battery recharges during non-constant current and voltage charging conditions. In an experimental setup the batteries will be used to drive a DC motor which will spin a rotational inertia. Using computer control the system will be able to convert electrical energy into mechanical energy by discharging the battery to drive the motor. It will also be possible to convert mechanical energy back into electrical energy using the motor as a generator which will then recharge the battery. It should be noted that this research is being conducted as part of a larger project to design a powered prosthetic leg for transfemoral amputees. Lithium polymer batteries are being used as the power source for this prosthesis, and this proposal will help investigate the feasibility of energy regeneration during normal operation of the prosthesis.

Applications of the Proper Orthogonal Decomposition to Particle Modeling

David Witman
Dr. Brian Helenbrook
Mechanical Engineering

Computer based modeling of fluid flows is quickly becoming a major component of both industrial and research activities. Often, companies and researchers must run large simulations repetitively with only slight variations. Reduced order modeling allows such simulations to be executed faster without sacrificing accuracy. This paper proposes the use of the Proper Orthogonal Decomposition (POD) as a reduced order modeling technique to model the flow over a sphere. Steady and unsteady incompressible flow over a sphere is important in numerous applications including fuel injection, particulate pollution and granular bed filters. Current approaches for computing drag on spherical particles include the Basset-Boussinesq-Oseen (BBO) equations or empirical formulas; both of which have their weaknesses. The BBO equations are only valid for low Reynolds numbers while empirical equations are not useful in unsteady flows. Given a set of detailed numerical data at different conditions, the POD generates an optimal set of functions representing the numerical data. These functions, known as modes, can then be used to create a low dimensional model for the drag on a sphere. In our case, we will apply this technique for steady-flows at different Reynolds numbers and for oscillatory flows. Four different permutations of the POD will be presented so that the most accurate method can be found. Preliminary results show that drag as a function of Reynolds number can be represented to within 1% error using as few as 10 modes. We also show that non-physical negative eigenvalues caused by round-off errors can be avoided by using a recursive approach to finding the POD modes

Thermal Modeling of Micro- and Nano-Scale Integrated Circuits

Ravon Venters
Mechanical Engineering

A 2D transient thermal model is constructed for a semiconductor using the reduced-basis element method (REM). REM uses functions derived from the proper orthogonal decomposition (POD) to allow predictions to be made with very few degrees of freedom. Furthermore, this method requires few assumptions about the geometry and boundary conditions. This approach can be applied to complex circuits and provided detailed thermal information. The computational time required to solve a thermal problem implementing REM is far less than previous methods, thus making this approach useful for predictions of circuits with millions or billions of transiestors. In this work, we explain REM and compare results to detailed numerical simulation (DNS), in order to illustrate its accuracy.

2011, Mechanical Engineering, McNair, Dr. Brain Helenbrook

A Hybrid Level-Set/Moving-Mesh Interface Tracking Method

Kyle Perline
MAE Department

Two methods for numerically calculating the evolution of a two-phase interface, such as the water-air interface in a boat wake, are the level-set and Arbitrary-Lagrangian-Eulerian moving-mesh methods. The level-set method represents the interface as the zero-level of a scalar function on a static mesh. This method easily handles topological changes in the interface, like a wave break, but is only second-order accurate. The ALE moving-mesh method uses two separate deformable meshes to represent each fluid, and the boundary where the meshes connect is the interface. This method is more accurate but is unable to accommodate topological changes. In this work a coupling boundary is created between these two methods that allows a single simulation to use both methods in different spatial regions. The level-set method can be used in regions where topological change is known to occur, such as near the boat hull, and the ALE moving-mesh method can track the interface in larger regions, like the propagating waves after the boat has passed. In this manner a simulation can readily handle topological changes and achieve a higher degree of accuracy. Results show that the hybrid model is as accurate as either method individually.

A Theoretical and Computational Investigation of the Effect of Diffuser Geometry on the Power Augmentation of a Diffuser Augmented Wind Turbine

Nathan Roskoff
Department of Mechanical and Aeronautical Engineering

Recent political and environmental concerns have motivated the search for renewable energy alternatives. Besides hydropower, wind is the next most economically viable source of renewable energy. However, the amount of power an open rotor can generate is limited by its size. This has driven the progression of turbine development. Early windmills had diameters of 15 meters and produced 50 kilowatts of power. Today turbines have diameters of 90 meters and can produce up to 4 megawatts [1]. An additional way to extract more power from the wind is to use a diffuser augmented wind turbine (DAWT), however DAWT's have not been thoroughly studied and this power augmentation has yet to be utilized. In this work, I will use theoretical and computational methods to study the performance of DAWT's.

[1] Ackermann, T. & Söder, L., *Renewable and Sustainable Energy Reviews*, 2000, Vol. 4(4), pp. 315 – 374.

The Physics and Engineering of Skateboarding's MegaRamp

Emily Stefano
Mechanical Engineering

The MegaRamp is a large ramp used for skateboarding that was designed by a professional skateboarder based on his experience. This research studied the dynamics governing the MegaRamp in order to develop an equation of motion that accurately models the dynamics of a skateboarder while riding it. Langrangian energy methods were used to derive equations of motion for the skateboarder. Motion tracking data was gathered from video footage by means of background subtraction and a linear Kalman filter prediction. The computer model and video data were combined using an optimization code to obtain an equation that accurately characterizes the system dynamics. This model was used to determine if the ramp could be modified or redesigned to improve a skateboarder's performance on the ramp. This research could result in a safer ramp and make the design process more exact for any similar ramps that are built in the future.

Bishop's Lemma for Function Algebras

Ryan Northrup
Department of Mathematics

Functions can be used to approximate, predict or model complex systems in many different ways in numerous fields. Many scientists and mathematicians use functions in those ways; however, functions may be studied differently as objects. In higher algebra, we learn that any polynomial in x is part of the family of functions created by $f(x) = x$ since polynomials are just powers, sums and scalings of x. A lot is known about the polynomials of $f(x) = x$, but if we create a family with another function say $g(x) = \cos(x)$, it turns out that we can still characterize many of the properties of the family. In this presentation, we focus on an entire family of functions generated by one generic function. We examine the maxima of the functions within the families, presenting results for some specific cases. We finish by explaining how to determine where maxima can and cannot occur for some particular families, presenting results where applicable.

2011, Mathematics, Honors Program, Dr. Aaron Luttman

Analyzing the Climate Dynamics of the High Peaks Region of the Adirondack Mountains

Ameerah Jabr-Hamdan
Dr. Aaron Luttman
Department of Mathematics

Temperature and precipitation have long been seen as direct climate measurements, while tree ring growth remained a mere climate proxy. Unfortunately, direct climate measurements have only been reliably recorded relatively recently, for some regions only within the past half century, while trees have been growing long before that. The goal of this project was to use patterns of repeated periods in the direct measurements of climate, such as precipitation, maximum and minimum temperature, to determine a connection with tree ring growth. The benefits of such a connection are that older trees may be used to find climates for times before direct climate measurements could be made, limited only by the age of the local trees. It also allows us to use tree ring growth information in the future as a reliable measure of climate, rather than direct measurements. This goal was achieved by looking at three specific locations, using data from 1980-2009 on maximum temperature, minimum temperature, and precipitation. These direct climate measurements were compared to tree ring growth data taken from the same geographical locations. For all four data time series, Empirical Mode Decomposition and the Fast Fourier Transformation were performed to search for patterns within each data set. Then the output of these tests for the direct climate measures and tree ring growth were analyzed with respect to each other.

Understanding the Impact of Boundary and Initial Condition Errors on the Solution to a Thermal Diffusivity Inverse Problem

Xiaojing (Ruby) Fu
Dr. Kathleen R. Fowler
Department of Mathematics and Computer Science

In this work, we consider simulation of heat flow in the shallow subsurface. As sunlight heats up the surface of soil, the thermal energy received dissipates downward into the ground. This process can be modeled using the traditional heat equation in time and space; the spatial distribution of soil thermal conductivities is a key factor in this process. Prior to this study, temperature profiles are recorded at different depths of the soil at various times. This work is motivated by trying to match these temperature profiles using a simulation-based approach and analytic approaches in the context of an inverse problem. Specifically we determine soil thermal conductivities using derivative-free optimization to minimize the nonlinear-least square errors between simulation and data profile. Here, we conduct two sets of studies, assuming homogeneous and heterogeneous soil environments respectively. We also study how errors in the initial and boundary conditions propagate over time using both a numerical approach and an analytical method.

2011, Applied Mathematics and Statistics, Honors Program, Dr. Kathleen Fowler

Autonomous Domestic Scale Wind Powered Heating System

Eliyah Khandaker
Sami Dawud
Mechanical and Aeronautical Engineering

The intent of this project is to design, develop, test and determine the feasibility of an autonomous, domestic scale wind powered heating system. This will be accomplished by directly coupling a self-starting Vertical Axis Wind Turbine with a custom made water break. Heat energy will be developed within the working fluid of the break via viscous shear. The intended result is to produce water hot enough to either be used for heating purposes or simple domestic scale consumption. Initial designs will be scaled to facilitate testing and analysis of the system.

The Design and Evaluation of a user Interface for the Visualization of Patient Data

Philip Hart
Dr. Edward Sazonov & Dr. George Fulk
ECE & Physical Therapy Departments

Usability is an important topic in the field of telerehabilitation research. Older users, in particular, present age-related challenges that should be accommodated for in the design of a user interface for a telerehabilitation system. This paper describes the design, implementation, and assessment of a telerehabilitation system user interface that tries to maximize usability for an elderly user who has suffered from a stroke. An Internet-connected Nintendo Wii™ gaming system was selected as a hardware platform, and a website was implemented using PHP and Javascript to process and display activity results. Elements of the Goal Directed Design (GDD) technique were used for the design of the visual display. Simplicity of function, large buttons, and highly readable font were emphasized. The usability of the interface was assessed with a trial consisting of 20 subjects, including 10 Doctor of Physical Therapy students and 10 people who had suffered from a stroke. Preliminary results from the 10 student subjects, as well as from several subjects who had suffered from a stroke, are encouraging.

Development of a Mobile Real-Time LIBS Detection Device

Andrew D. Sheldon
Dr. Jeremiah J. Remus
Electrical and Computer Engineering

Laser Induced Breakdown Spectroscopy is an emerging technology with the ability to identify solids, liquids, gases, and aerosols. Due to the wide range of testable materials, and the lack of a need for sample preparation, LIBS has multiple applications. Current LIBS research projects have focused on the identification of explosives, bio-weapons, and conflict minerals. Recent work at Duke University has produced a real-time chemometrics toolbox capable of generating a chemical signature for specific compounds. Despite this exciting development, and the existence of portable LIBS sensors, the technology remains hindered by bulky computer systems and complex graphical user interfaces.

This project aims to create a simplified, mobile computing solution for LIBS systems utilizing the work of the Duke University team. The platform will be designed to implement previously developed algorithms and those created in the future. It will consist of an embedded computing device, capable of interfacing with and controlling a LIBS sensor, analyzing test data in real-time, and presenting its findings to the user.

Presently, this project is focused on development for Windows Mobile 6 under version 3.5 of the .NET Compact Framework. Communication with the LIBS sensor is accomplished via a Bluetooth serial connection. Differences between the architecture of handheld and larger computing devices has caused difficulties in porting existing software to a mobile platform. However, the modularity and levels of abstraction present in this design enables development work to proceed while new communication software is developed.

Analysis of Open Source and Proprietary Anti-Virus Signatures

Jon Deane
Mathematics and Computer Science

In choosing anti-virus software for a personal computer or a server, it is important to know how effective that software is in comparison to other anti-virus software. Of particular interest is weather open source (software where the source code is made available, allowing for third parties to help develop the software and fix bus) or proprietary (software where the source is unavailable and all support comes from the company or individual that owns it) anti-virus software is more effective at detecting viruses. This research project attempted to analyze the signatures of three anti-virus programs, one open source and two proprietary: ClamAV, Microsoft Security Essentials, and Symantec Endpoint Protection.

The signatures were used to compare the effectiveness of the three pieces of software. ClamAv's signatures were extracted and parsed with a python script to determine how many viruses were detected as well as the distribution of viruses and signature types. Results indicate that ClamAV detects mostly trojans, but the analysis of Microsoft Security Essentials and Symantec Endpoint Protection was inconclusive because those both use encrypted signatures that are not easy to analyze. The sizes of a signature update for each program were also compared. It was found that ClamAV's signature files also take up a lot less space than the signature files of the proprietary software, which could indicate either that ClamAV detects less viruses or that it stores its signatures in a more efficient way.

A Physics Based Thermal Circuit Model for FinFETs

Paul Russell
Dr. Ming-Cheng Cheng
Electrical and Computer Engineering

The FinFEt is a multigate transistor, a strategy being developed by semiconductor manufacturers to overcome short channel effects in traditional planar transistors to create smaller microprocessors and memory cells. Due to the geometry of the FinFET the heating problem has dramatically increased. Self-heating in the FinFET results in degradation in overall device performance. It is therefore crucial for chip designers to consider thermal influences on device/interconnect/chip performance and their reliability. A typical Integrated Circuit (IC) chip consists of millions of transistors, making direct numerical simulation impractical. Accurate thermal models for the FinFET that is detailed enough to provide the device temperature profile and efficient enough for large scale electro-thermal simulation are therefore strongly desirable. In order to model the heat flow through the FinFET, the island is divided into uniform regions and for each interface between adjacent regions temperature and heat flux continuities are applied. Due to the uniform power generation along the device width direction, the problem of heat flow along the thin island is reduced to a 1D problem if the heat flow out of the island is treated as losses. Once the solution in each region is obtained, a thermal circuit can be derived for the FinFET and simulated in SPICE. The resulting thermal circuit yield results with less than 5 percent error when compared against results from the finite element simulations.

The Effects of Electric Vehicles on the Clarkson University Electrical System

Nathan Côté
Electrical Engineering

My research since the summer of 2010 has been focused on the implementation of electric vehicles on the Clarkson University campus, and the effects of these vehicles on Clarkson's electrical system. The popularity of electric vehicles is increasing with time as gas prices rise and new models, such as the Nissan Leaf, are released to the public. This increase in popularity will result in larger numbers of electric vehicles present on the Clarkson University campus. These vehicles could affect the electrical grid at Clarkson in an adverse way and cause economic issues as well.

Every electrical system has a certain capacity, meaning that it can carry up to a certain amount of electricity before being overloaded. Electric vehicles may or may not cause problems with this electrical system depending on the number of electric vehicles, where they are charged and what type of charger is used.

The purpose of this research is to determine the potential issues facing Clarkson when electric vehicles are implemented on campus. This research covers three unique scenarios of electric vehicle usage: maintenance vehicles, faculty and staff vehicles and community vehicles. These three scenarios cover a broad spectrum of types of vehicles, charging styles and location of charging, thus allowing for a diverse analysis of potential issues.

Breathing Detection in a Portable Apnea Detection Unit

Owen Manley
Electrical and Computer Engineering

Apnea, the suspension of breathing, is a condition that affects millions of people; many of whom are completely unaware of the condition. Apnea can contribute to a variety of life threatening medical conditions. A device is being developed which will be a discreetly wearable monitor that records both oxygen saturation of the blood and respiratory rate in order to detect, record, and alert users of apnea events and help them to recover. The purpose of this research was to explore the use of a simple contact microphone as a means of breathing detection. A contact microphone was constructed from a simple piezoelectric transducer and data was collected from 20 human subjects to train and test the accuracy of a breathing detection algorithm. In this data collection, breathing sounds, nasal/oral air flow, and chest expansion were recorded while subjects performed various activities of daily living. Several detection algorithms were constructed each relying on analysis of the power distribution of the signal based on the Short-Time Fourier Transform and pattern classification techniques ranging from a simple decision tree to a full artificial neural network. A large amount of variability between the characteristics of samples recorded from different subjects was observed and reflected in the poor performance of the breathing detection algorithms. A large set of data is being collected on a single subject to evaluate the performance of the algorithm trained to a specific individual's breathing.

Sexual Size Dimorphism in Seabirds

Jane Casey
Biology

Sexual size dimorphism is the difference in form between females and males of the same species. Previous research has studied sexual dimorphism in seabirds of the southern hemisphere (Fairburn et al. 1993), but the research was based on only a certain geographic location. The objective of this study is to investigate how sexual size dimorphism varies with body size across species of birds from a variety of different regions. The seabird data collected for the present research was selective for post breeding season marine range over oceans or seas, whether pelagic or large range away from land mass. Seabirds were then divided into three major feeding methods: surface-feeding, aerial feeding, and dive-feeding; this was based upon a literature of published data. The predicted outcome for this research is that the way sexual size dimorphism varies with body size may depend on constraints associated with how seabirds feed. Strong correlations to Rensch's rule were found to be present among two of the three feeding methods, with one being isometric; significant differences among females and males are present in the data. Conflicting factors present in the study were also accounted for (including sex incubation, bonds, and habitat).

Motility of the GI tract of *pia* Zebrafish Using Volumetry

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Biology

Serotonin is an essential neurotransmitter that regulates motility in the digestive system. *Pia* is a mutant that lacks serotonin in the gastrointestinal tract in addition to having few enteric nerves. Enteric neurons are involved in motility of the GI tract in an embryo. The altered levels of serotonin and changes in enteric neuron development cause *Pia* mutants to undergo noticeable changes in their motility. Using the program SPOT to record motility at 5dpf, the data was then analyzed in Volumetry to detect changes in motility. Recordings were made with wild type, mutant, and injections that added serotonin into the mutant to change motility. The wild type recordings showed steady and frequent contractions in the anterior and the posterior parts of the intestine. Initial results show that in the *pia* mutants, there was decreased motility in the posterior section but a similar motility to wild type in the anterior. Mutants that were injected with serotonin showed improved movement in the posterior portion of their digestive tract compared to mutants injected with only buffer. These injections, however, did not restore wild type motility but instead showed slower retrograde contractions. Further investigation will study the effect of varying drugs on the intestinal movement as well as look into the possible presence of a sphincter in between the anterior and posterior regions.

Use of a Housekeeping Gene to Quantify Expression Levels of Specific Defensins in HPV-Infected Cell Types

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Defensins are small, cationic proteins of the innate immune system that carry out antimicrobial activities. They act as part of the immune response to eliminate pathogens that would infect and do harm to the body. Studies have shown that alpha-defensins are found at sites of chronic inflammation and beta-defensins are found throughout epithelial sites such as the tongue, skin, respiratory tract, and esophagus – denoting their importance as one of the first lines of defense against microbial infection. We examined the defensin genes DEFB107 and DEFA4, along with the housekeeping gene Cycolphilin A to determine the level of expression between three cell types: normal, immortal, and tumor (the latter two of which were infected with Human Papilloma Virus). Forward and reverse primers were designed for each gene, and cDNA reverse transcribed. Expression of the gene in each cell type was determined by analysis of the results of multiple RT-PCR processes. Our preliminary findings revealed that Cyclophilin A was not expressed evenly among the three cell types as expected; thus, negating any chance to use it to check expression levels of DEFB107 and DEFA4. In turn, we used the previously-evaluated housekeeping gene Beta-Actin to quantify the expression of the two defensins. It was determined that DEFB107 and DEFA4 were not significantly different in their expression levels between the three cell types. However, another beta-defensin assessed beforehand - DEFB103 - was down-regulated in HPV and immortal cell lines. These results suggest that HPV in immortal and tumor cells does not alter the expression of DEFB107 or DEFA4, but may down-regulate expression of DEFB103.

Involvement of Different Notch Receptors and Ligands in the Choice between Absorptive and Secretory Cells in the Zebrafish Intestinal Epithelium

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Biology

The Notch signaling pathway has been identified as the primary pathway which controls the binary fate between absorptive or a secretory cell within the epithelial cells of the intestinal tract. Future secretory cells begin producing Notch ligands and activate Notch signaling in neighboring cells to promote the absorptive fate. The alterations in the levels of the secretory cells producing Serotonin have been associated with diseases within the intestine including Irritable Bowel Syndrome (IBS) and Inflammatory Bowel Disease (IBD). Zebrafish are used as a model organism in this study because of similarities in their structure and function with other types of vertebrates. The genetics and organ structure of zebrafish digestive system is analogous to other vertebrates. Use of the zebrafish model system will help to reveal a common pathway for vertebrate digestive development. Through RNA in situ hybridization, our lab will focus on discovering the specific notch receptors/ligands involved in the choice between specific secretory and absorptive cells.

Multigene Phylogenetic and Geometric Morphometric Analysis of the *Calotes versicolor* Species Complex

Jane Simpson
Biology

Over the last 20 years, genetic data has been increasingly used in species descriptions. This has led to a steady increase in the discovery of cryptic lineages that have been missed due to traditional morphology based methods lacking information to find differences between those lineages. A multievidence approach has become essential in identifying and describing these new, cryptic lineages that combines, genetic, morphology, geographic, and ecological data. We use this approach to assess comparative levels of genetic variation present in the *Calotes versicolor* (garden lizard) species complex using phylogenetic analysis of mitochondrial DNA and the nuclear encoded *RAG1* gene. Mitochondrial DNA show significant differentiation among several lineages and the possible existence of more than one distinct evolutionary lineage within the *Calotes versicolor* species complex, while trees derived from RAG1 data are less resolved due to lack of informative characters. These genetically defined "species" or groups correlate to nonoverlapping geographic areas distributed throughout Southeast Asia. Morphometric data show some differentiation between eastern Asian populations of *C. versicolor* and the specimens from the type locality in India, as well as recently described Myanmar species. But among the three East Asian lineages both males and females analyzed separately also show some differentiation with one lineage broadly overlapping all taxa in morphospace.

Expectations of Clumpy Resources Influence Predictions of Sequential Events

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When predicting the next outcome in a sequence of events, people often appear to expect streaky patterns, such as that sport players can develop a "hot hand", even if the sequence is actually random. This expectation, referred to as positive recency, can be adaptive in environments characterized by resources that are clustered across space or time. But how strong is this disposition towards positive recency? If people perceive random sequences as streaky, will there be situations in which they forego a payoff because they prefer an unpredictable random environment over an exploitable but alternating pattern? Starting with an overview of recent findings from Scheibehenne, Wilke & Todd (2010), we present future directions that explore the boundary conditions of the hot hand phenomenon as a cognitive adaptation to clumped resources.

Comparing Initiatives and LCA Model that Estimate GHG Reductions from Anaerobic Digesters

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Anaerobic digestion has been touted as a means of reducing greenhouse gas (GHG) emissions associated with dairy manure management. Currently, there are three methods that try to account for GHG gas emissions when anaerobic digesters are implemented in order for farmers to sell their GHG credits: the Regional Greenhouse Gas Initiative (RGGI), California Climate Action Registry (CCAR), and US EPA initiative. The goal of this study was to compare the estimates for GHG emissions from these different initiatives to the estimates determined through a recently completed a lifecycle assessment (LCA) model to observe the differences in the amount of GHG were emitted when anaerobic digesters were implemented on the farm. This also included comparing the GHG reductions before AD is implemented. The approach used the same farm data, North Harbor Dairy Farm in New York, to compare among the methods. The baseline results showed significant differences in estimated GHG emissions, with decreasing amounts from CCAR, RGGI, US EPA, and LCA model. The GHG reductions showed that the digester did enable a reduction in emissions with US EPA and CCAR when the regulators considered certain assumptions. The LCA model and RGGI initiatives showed an increase in GHG emissions when AD was implemented. The differences between the initiatives included different fugitive emission rates from the anaerobic digester and methods for calculating annual emissions from AD. US EPA had the widest range of emissions or reductions due to their implementation of the IPCC Methane Conversion Factor (MCF). MCF is a conversion factor, which converts monthly data into annual emissions within one equation.

Anti-biofouling Elastomeric Block Copolymer Coatings

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Zwitterionic polymer surfaces have shown good resistance to protein adsorption and cell adhesion because of their hydrophilic nature. We are interested in the anti-biofouling properties of ionic block copolymers consisting of *N*-(3-(dimethylamino)propyl)acrylamide and 4-vinylpyridine precursors. Bilayer coatings are prepared on thermoplastic polystyrene-*block*-poly(ethylene-*ran*-butylene)-block-polystyrene substrates and investigated for resistance to protein adsorption and cell adhesion. The preparation of these coatings will be discussed.

Synthesis and Purification of Deuterium Labeled Curcumin and Other Derivatives

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Curcumin is known in the culinary world as the yellow pigment found in turmeric. In the chemical world, it has recently become a natural product of intense interest due to its possible use in many applications. It is speculated that curcumin may possess antioxidant, anticancer, anti-inflammatory, anti-tumor, anti-viral, anti-mutagenic, and anti-microbial characteristics. The compound's symmetric structure possesses two phenolic cinnamoyl units connected to one central methylene carbon. In order to further understand its mechanism of action with the cell membrane, selectively deuterium-labeled curcumin derivatives at the α and β carbon sites were synthesized through an aldol condensation with labeled precursors. These precursors, acetylacetone-d_6 and vanillin-d, were prepared either by direct hydrogen deuterium exchange or through organic synthesis, respectively. Other non-labeled derivatives were also prepared by modifying aldol condensation precursors. ^{1}H-NMR and ^{13}C-NMR spectroscopy analysis were used to determine the composition, purity, and extent of the labeled products. Difficulties in purification due to curcumin's solvent interactions had to be overcome through adjustments in the reported synthetic procedure.

2011, Dual Chemistry and Biomolecular Science, University of Michigan's Chemistry Department's NSF-REU Program, Dr. Masato Koreeda

Over-Expression, Purification and Characterization of Tumor Differentiation Factor Protein

Marty LaFleur
Izabela Sokolowska & Dr. Costel Darie
Department of Chemistry and Biomolecular Science

The intent of this research is to produce large quantities of Tumor Differentiation Factor (TDF) protein that will be used for isolation, purification, identification and characterization of its receptor (TDF receptor, TDF-R). TDF protein will also be used to investigate its effects on cell differentiation in MCF7 steroid-responsive and MDA-MB-231 steroid-resistant *human breast cancer cell lines, MCF10A* normal human breast epithelial cells and HDF-human dermal fibroblasts. To do this, E. coli K12 strain was transformed with pET22b plasmid containing the tdf gene. The tdf gene has two tags: 6xHis tag and Flag tag at its N- and C-termini. Expression of TDF protein was induced by IPTG (isopropyl-beta-D-thiogalactopyranoside). To test for a successful expression, the bacteria were lysed, run through SDS-PAGE, and subjected to either Coomassie staining or Western blotting using anti-TDF antibodies.

To purify the TDF protein (the 6xHis-tag was used), the cell lysate was loaded onto a Ni column (Ni specifically binds 6xHis proteins), washed and then eluded with imidazole-containing elution buffer. The washing fractions (flow through, wash from wash buffer, first elution, and second elution) were analyzed by SDS-PAGE and Western blot. In our preliminary data, we concluded that TDF protein was produced in bacteria and it was detected in both Coomassie-stained gels and in Western blotting. Currently, we are working on optimization of the conditions for purification of TDF and on its large scale purification.

Effect of NF-kB on HPV-16 Gene Expression

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As one of family of transcription factors, NF-kB not only can promote cell growth, but also it controls genes involved in inflammation. HPV-16, a specific type of human papilloma virus, contributes to development of cervical cancer. At an early step in cancer development, the upstream regulatory region (URR) regulates expression of HPV E6 and E7 and results in HPV-16 causing immortalization. There is a functional NF-kB binding site in the URR that has ability to decrease HPV gene expression.

We asked whether NF-kB inhibits immortalization of HPV-16 by down regulating the HPV promoter in the URR. Reporter gene assays were used to measure upstream regulatory region activity. We used p65 to overstress NF-kB. Preliminary results indicated that expression of p65 inhibited expression of HPV upstream regulatory region in cervical cells; however, the effect of p65 in foreskin cells was imprecise. IKba was used to inhibit NF-KB expression. Experiments involving the IKba dominant negative mutant to block NF-kB are in progress. We expect to see that increasing NF-kB inhibits HPV-16 URR, and decreasing NF-kB stimulates HPV-16 URR in both foreskin cells and cervical cells.

Information Foraging in a Patchy Memory Environment

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When resources are distributed in patches animals must decide when to switch from a depleted patch. The optimal policy is given by the Marginal Value Theorem, which has successfully predicted animal behaviors, but as a mechanism it becomes problematic when each patch contains few discrete prey items. Biologists have proposed simple alternative decision mechanisms and calculated in which environments each works well. Hutchinson, Wilke & Todd (2008) and Wilke, Hutchinson, Todd & Czienskowski (2009) tested whether the decision mechanisms that evolved to direct animals when to leave a food patch also underlie human decision making in the same context, and whether humans in an internal-search task (e.g., information in memory) use the same mechanisms as in an external-search task (e.g., physical objects). Here, we extend this research by adding a developmental perspective and assess younger and older adults' ability to master exploration-exploitation decisions in search from memory.

Automated Sample Stage for Laser-Induced Breakdown Spectroscopy (LIBS) Data Collection

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Laser-induced breakdown spectroscopy (LIBS) is a type of atomic emission spectroscopy which uses a highly energetic laser pulse as the excitation source. The laser is focused to form a crater of plasma, which atomizes and excites samples. LIBS can analyze any matter regardless of its physical state, be it solid, liquid or gas. This technology is exciting for its ability to detect any element; limited only by the power of the laser and the sensitivity, and wavelength, of the spectrograph and detector.
Several characteristics of LIBS technology (e.g. rapid measurements, no need for sample preparation) make it well-suited for field use. However, additional work is necessary to allow the use of LIBS technology by operators with minimal training. In particular, the data collection process has been shown to be sensitive to the setup of the laser and optics apparatus. Automating the optimal configuration of the data collection mechanism will produce higher-quality data, yielding more robust results for material analysis and identification.

In this project, we will focus on developing a control system, programmed in MATLAB, to manage, command, direct and regulate the behavior of a linear translation stage. The development of this control system will provide the high-resolution motorized positioning needed when working with LIBS technology. The physical setup of the project consists of a motor controller, stepper motor, and translation stage.

2013, Computer Engineering, Collegiate Science and Technology Entry Program, Dr. Jeremiah James Remus

Modeling the Interphase Mass Flux between PCE and Aqueous Permanganate Solutions in the Presence of Surfactants: Experimental Design

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Both in situ chemical oxidation (ISCO) and surfactant enhanced aquifer remediation (SEAR) are groundwater remediation techniques used to remove organic pollutants from the environment. As with most “pump and treat” efforts, the aim of these practices is to utilize the fundamental knowledge of aqueous chemistry to remove (in the case of surfactant solubilization) or destroy (in the case of in situ oxidation) environmentally dangerous chemicals. The biggest obstacle with such techniques is the fact that the organic pollutants are often immiscible and much denser than the fluid used to treat them, making removal extremely difficult. Within recent years, many efforts have been made to combine these two techniques in an attempt to simultaneously remove *and* destroy organic pollutants from known source zones. While both remediation methods have been studied extensively on their own, a new approach that combines the two techniques is still in its infancy. This project attempts to determine how the addition of surfactants alters the oxidation processes due to the increased dissolution rate of PCE into the aqueous phase. In doing so, a reactive dissolution model has been employed to determine the interphase mass flux. Through Runge-Kutta methods, solutions for the reactant concentration profiles within the “diffusive layers” can be predicted. By modifying model parameters such as the molecular diffusion coefficient and reaction rate constant, the effects of surfactant molecules can be incorporated. An experimental method for verifying the obtained mass flux values is also presented.

2012, Chemical and Biomolecular Engineering, Institute for a Sustainable Environment, Dr. Michelle Crimi

A Systematic Study for Comparison of Ultrafine Particles Emitted during Frying

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Since airborne particulate matter (PM) has great adverse effects on human health, indoor air pollution has increasingly become a significant and popular area of study. Previous research suggests that more than 90% of emitted particles during frying are in the ultrafine particle (UFP) range, which can cause much more problems on human health.(Wallace et al, 2004) And the majority of aerosols emitted from frying comes from the cooking oils.

My research project is aimed to reveal ultrafine particles, emitted from seven kinds of cooking oil which are commonly used at home and restaurants. Aerosol technology, which includes Wide-size Particle Spectrometer, Aethalometer, Piezobalance and DustTrak, is applied for testing the size distribution of particles, the ratio of black carbon, and total mass of particles. Additionally, the smoke temperatures of these cooking oils are measured.

This project is not intended for persuading people to give up traditional cooking habits, but to provide cooks with suggestion based on health concern. The results show that the emission from olive, corn and coconut oils has higher number concentration as well as $PM_{2.5}$ mass concentration. Peanut oils generate low mass particles but high number particle concentration. Also, compared with other kinds of cooking oils, peanut, safflower, and canola oils have relatively high smoke temperature, which are favourable. To conclude, in order to directly lower exposure to the oil emission, it is recommended to cook using canola and safflower oils.

Active Flow Control for a Small-Scale Wind Turbine

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Intelligent active flow control strategies can allow power to be extracted from wind turbines more efficiently by increasing the range of wind velocities in which the wind turbine can safely operate. To evaluate the performance effects from such a system, a small-scale wind turbine has been outfitted with a blowing-type active flow control mechanism. The effect of the system's chord position on power output is being investigated. Moreover, the effect of the active flow control system on power output is being quantified at different wind velocities.

2012(Abell), 2011(Hunold), Mechanical and Aeronautical Engineering, McNair, Dr. Pier Marzocca

Family and Peer Influences Associated with the Smoking Behavior of College Students

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Research suggests that young adults' immediate social context has great influence on their smoking behaviors. Young adults are more likely to become smokers if they have family members or friends who smoke. These models are significant because they give social reinforcement for the smoking behavior and demonstrate the positive outcomes associated with smoking. The purpose of this study was to determine which smoking influences are the strongest predictors of smoking behaviors among college students between the ages of 18-24. Participants were 2,127 college students at Clarkson University and Temple University who completed a survey about their smoking behaviors as well as that of their family and friends. In total, 339 students (16%) were smokers, and 1,788 (84%) were non-smokers. Significantly more smokers (70%) than non-smokers (19%) had a best friend who smoked cigarettes, ($p<.001$). Additionally, it was found that more smokers (50%) than non-smokers (10%) reported that their boyfriend or girlfriend smoked, ($p<.001$). Participants who smoked had more siblings who also smoked (31%) than non-smokers (16%), ($p<.001$). However, only 13% of smokers reported having a mother who smoked with 11% of non-smokers having a mother who smoked, ($p<.001$). Similarly, only 19% of smokers reported having a father who smoked and 13% of non-smokers said they had a father who smoked, ($p<.001$).The results of this study indicate that young adults are likely to engage in the same behaviors as those in their close social environment, and therefore their influences contribute as a factor that may drive young adults into smoking.

Evidence for Sensitization of Somatic Threat Detectors in the Human Brain

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Behavioral studies have demonstrated an attentional bias towards threats to the body (somatic threat). For example, the reaction times for somatic threat targets presented outside the focus of attention (unattended) are faster than that for unattended non-threatening somatic or visual target stimuli. Our studies suggest that this attentional bias is due to a bottom-up threat detection process, where threat detectors in the dorsal posterior insula aid in shifting attention towards the unattended threatening target. Alternatively, there may be a top-down process where the subject voluntarily allocates some attention to the somatic threat target even when they are instructed to attend to a visual target. In this experiment we presented painful (threatening) and non-painful (non-threatening) somatic stimuli, and non-threatening visual stimuli in both attended and unattended conditions. The electrophysiological data were consistent with the threat detection hypothesis, where the dorsal posterior insula threat detector activity was larger in the unattended than in the attended condition. Unexpectedly, this was the case for both the non-painful and painful somatic targets. This contrasts with our earlier work showing that non-painful somatic stimuli do not activate the threat detectors when they are presented in the absence of any somatic threats. This suggests that the dorsal posterior insula threat detectors become sensitized to non-painful stimuli when they are presented in the same context as painful stimuli. Consistent with this hypothesis, both the non-painful and painful somatic targets exhibited faster reaction times in the unattended condition than in studies where only weak non-painful somatic targets were given.

Notch Signaling Components in the Choice between Secretory and Absorptive Cells within the Zebrafish Digestive Epithelium

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Biology

The choice between secretory and absorptive cells in the vertebrate digestive epithelium is dependent on Notch signaling. Activation of Notch signaling depends on upregulation of positive transcription factors in future secretory cells which subsequently up-regulate ligands for Notch activation. Differentiation of absorptive cells depends on Notch receptor activation by ligands produced on neighboring cells, which up-regulates a class of negative transcription factors. Removal of or increases in components of this pathway will lead to more secretory or apsorptive cells in the epithelium depending on what is altered. Within the Notch pathway, there are multiple positive and negative transcription factors, Notch ligands, and receptors. We have begun to analyze the distribution of these genes during the time when this choice is made to determine which variations of these genes are used in this choice. We have first begun analyzing the expression patterns of the negative transcription factors *her 3* and *her 6*.