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12th Annual Symposium

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Clarkson University

July 29, 2010

Bertrand H. Snell Hall

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12th Annual Summer Symposium on Undergraduate Research Experiences (SURE)

Clarkson University
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Bertrand H. Snell Hall Atrium
212, 213, and 214 BSH

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Phytoplankton Interactions at Goose Neck-Island Shoal on the Saint Lawrence River

Katie Carroll
Biology

It has been shown that there is a significant decrease in phytoplankton population in the St. Lawrence River as it flows downstream from Lake Ontario (Twiss et al. 2010), and the cause of this decrease is not fully understood. This study explored the hypothesis that areas of increased submerged aquatic vegetation (SAV) populations, such as submerged islands (or shoals), are an important cause of the decrease observed. This could be caused by nutrient competition between SAV and phytoplankton (Kalff 2002), by allelopathy (Fitzgerald 1969, Erhard and Gross 2006), and by the abundance of grazing organisms associated with SAV (Twiss et al. 2010). In my study, Goose Neck Island Shoal (GNIS) in Waddington, New York, was chosen as a representative to explore phytoplankton dynamics around a shoal. This study first characterized the basic limnological properties of the shoal, including the surface area of the land mass and the volume, velocity and vector of water flow over the shoal. The SAV was characterized by snorkeling from the R/V *Lavinia*, and the effect of SAV on phytoplankton populations was explored through a series of assay experiments. The phytoplankton biomass and nutrient levels around the shoal were determined by the collection of water samples from ten stations upstream and downstream of the shoal. Chlorophyll-a levels were then determined by fluorometry. No significant change was observed in total phytoplankton population size across the shoal, but differences within size fractions are apparent. Further study is needed to verify the trends of growth and loss around the shoal.

Evaluation of Volatile Organic Compounds as Unique Indicators of Human Odor

Teresa Long and Patricia Beutel
Dr. Alan Rossner
Institute for a Sustainable Environment

This preliminary study sought to validate analytic techniques applied when sampling volatile organic compounds (VOCs) that emanate from human skin. These compounds, responsible for human odor, are thought to have potential as unique identifiers that, when separated and analyzed, create a characteristic scent profile: an "odiferous fingerprint." VOCs from the skin of four test subjects were collected using solid phase microextraction (SPME) in two different collection environments: isolation of a single patch of skin by means of a glass funnel and concentration of fully-body emissions in a lightweight chemical protective suit. Following sample collection, the compounds were analyzed using gas chromatography and identified with mass spectrometry; the resultant chromatograms were compared on an individual basis as well as amongst multiple individuals using Microsoft Excel. Results were assessed for uniqueness, consistency, and potential for repeatability. As a preliminary pilot study, the results of the collected and analyzed data will be used to optimize sampling methodology and give validity to the core principles that guide applications of human VOC profile analysis in the fields of law enforcement, forensics, and medicine.

2012, Environmental Health Sciences and Engineering at the University of North Carolina at Chapel Hill, Clarkson University REU Program, Dr. Alan Rossner

Comparison of Restored versus Natural Wetlands using Fish and Amphibian Larvae as Bioindicators of Wetland Quality

Kallen E. Frey
Catherine E. Benson and Dr. Tom A. Langen
Biology

Wetland restoration is used as a conservation tool by compensating private landowners for preserving wetland habitats. Government agencies such as the US Fish and Wildlife Service (USFWS) and the US Department of Agriculture (USDA) offer private landowner incentive programs targeted at restoration. These wetland restoration programs are aimed at rehabilitating degraded wetlands or reestablishing a wetland that has been destroyed. The quality of restored wetlands can be determined through comparison to natural reference wetlands in the same area. Recent studies conducted on the use of restored and natural wetlands suggest that they provide a diversity of biological responses such as amphibian breeding and fish rearing (Henning 2004). Post-restoration monitoring of restored wetlands can provide a measure of biological responses, and thus potentially gauge the quality of the restored wetland. Monitoring of 14 restored and 3 natural reference wetland sites was conducted from May 24 - June 25, 2010. This was performed using a minnow trapping method designed to capture fish and amphibian larvae, and the larvae was used as bioindicators of wetland quality. Results from statistical analyses of the collected data indicate that wetland type (restored vs. natural) and region are not significant predictors of species richness, trap success, or species diversity. In addition, wetland type is not a significant predictor of the presence or absence of newts, amphibians, and fish. In conclusion, the results show that restored and natural wetlands support similar communities of fish and amphibian larvae.

Perceptual and Economic Factors Affecting Choice

Joshua Felch
Biology

Many factors affect the decision making process in animals. This research investigates how these factors change the course of action of an individual making a decision. My study examines the hypothesis that risk of interruption affects sampling and choice in blue jays when selecting a nut to store, predicting that an increased perception of risk results in a faster choosing rate, less sampling, and a less accurate choice. The jays were presented a pool of peanuts from which to choose then heard broadcasted calls that increased the level of perceived risk. We compared the jays' sampling and choice behaviors to an optimal choice model.

Amphibian Use of Restored and Natural Wetlands in the St. Lawrence River Valley, NY

Eric Marcy
Dr. Tom Langen and Catherine Benson
Biology

Over the past few decades, a large number of wetland restoration projects have been employed in the St. Lawrence River Valley of New York to combat habitat loss and wetland degradation. The two major programs that restore and protect wetlands in this area are the National Resource Conservation Service, Wetland Reserve Program, and the U.S. Fish and Wildlife Service, Partners for Fish and Wildlife Program. We have examined 8 natural and 22 restored wetland sites from these two programs to determine if wetland restorations create an adequate habitat for amphibians. Anuran choruses were surveys in the summers of 2009 and 2010 with methods consistent with the Great Lakes Marsh Monitoring Program. Call choruses recorded at each site were used to determine if species richness or abundance differed between the wetland types (restored and natural). There was no significant difference in the species richness and abundance between natural and restored wetlands. It was also determined that wetland type was not a significant predictor of the presence or absence of the 10 species of frogs and toads detected. We conclude that restored wetlands provide the same quality of habitat as natural wetlands in this region and recommend that restored wetlands continue to be monitored to ensure that populations of amphibians remain healthy at restoration locations.

Perceptual and Economic Factors Affecting Choice

Michael Rolleston
Dr. Tom Langen, Dr. Joseph Skufca, Joshua Felch,
Brianna Christopherson and Marie Rogers
Psychology

Decision making in humans ideally occurs by collecting information about options before choosing. Our study tests how risks of interruption affect this collection process. We predict that with heightened risks of interruption, total items sampled will diminish. The experiment involves lifting weighted plastic eggs, with the object of selecting the heaviest egg among a tray of options. Payoffs are given dependent on the weight of the selected egg, but each sample comes at a cost. The risk of interruption, with three levels, may result in premature termination of the search. Our findings should reveal how humans adjust sampling and choosing.

Environmental Monitoring Sensor Platform with Integrated Spatiotemporal Tracking

Samantha Arnold
Civil and Environmental Engineering

The recent oil spill highlights the inefficiency of current technology in analyzing and dealing with such problems. Current technology limits the effectiveness of monitoring systems because each sensor is independent and platforms are cumbersome. Due to their limitations these platforms are mainly used in long term monitoring of small areas and relatively incapable of responding to crises. They are also unable to reliably track their position relative to time and relay this to the data processor wirelessly. By combining all the sensors into one small platform and utilizing a new inertial tracking system the data collected will be more accurate and consistent. Also being developed is a buoyancy control system to allow the user to analyze the entire vertical water column. This platform could be used to do long term monitoring or emergency testing quickly and reliably which is necessary for reducing human impact on an ecosystem.

The Use of Landfill Leachate and Waste Heat to Sustainably Grow Algae for Biodiesel

Bethann Parmelee
Civil and Environmental Engineering
Honors

The Developmental Authority of New York (DANC) Solid Waste Management Facility currently produces a large quantity of waste heat. In order to amend this sustainably, the growth of algae to produce biodiesel is recognized as one approach to utilize the available energy released from the facility. The water demand for growing algae is larger than DANC can provide, but the landfill's nutrient rich leachate could be a convenient means to fulfill this requirement sustainably. A feasibility study was necessary to determine if the high concentrations of nitrate and phosphate that aid in growth will be inhibited by other toxic components. Assays were performed over varying dilutions of the leachate for two algae, *Chlorella protothecoides* and a sample isolated from a high nutrient-concentrated wastewater lagoon. In order to determine the optimal metabolism for these purposes, algae grew under both autotrophic and heterotrophic conditions. Cell counts performed over time provided data for cell densities and growth rates. Autotrophic growth was found to be optimal, as heterotrophic growth yielded significantly lower cell numbers and growth rates. The lagoon species yielded higher growth rates and numbers over the lower leachate concentrations, while *C. protothecoides* growth rates generally dominated the higher concentrations. An analysis of lipid content will determine if growth is sufficient for biodiesel production.

2012, Environmental Engineering, Honors, Drs. Susan Powers and Michael Twiss

Effects of Organic Loading on Two-Phased Anaerobic Co-Digestion of Lactose and Glycerol with Dairy Manure

Ryan Ziels and K. Venkiteshwaran,
Stefan J. Grimberg
Civil and Environmental Engineering

Due to economies of scale, a rising supply of animal waste is being generated from a growing number of large confined agricultural feeding operations (CAFOs) in America. This manure is being applied to limited land, thus potentially causing concern of environmental pollution. Anaerobic co-digestion is a technology that can viably treat dairy manure together with agroindustrial wastes while producing renewable fuel (methane) as a byproduct. Previous studies have indicated that increased process efficiency, and thus cost-effectiveness, is achieved in two-phased digestion systems versus single-stage. The objective of this study was to determine the effects of organic loading and co-substrate composition the performance and stability of the two-phased anaerobic co-digestion of lactose and glycerol with dairy manure. Laboratory-scale two-phased systems were constructed out of glass serum bottles, and were fed a mixed waste of dairy manure with varied levels of both lactose and glycerol. Substrate degradation pathways were monitored, and the total system performance was analyzed based on the total methane yield. Results indicate that both organic loading and substrate composition affect the intermediates formed during acidification. The methane gas production rate (GPR) was influenced by the varied levels of intermediates, especially acetic and propionic acids. Reactors co-digesting lactose achieved up to 30% increased methane GPR over the control ($p=0.001$, $\alpha=0.05$), whereas reactors digesting glycerol observed no improvement in methane GPR ($p=0.36$, $\alpha=0.05$). Instability was observed at the highest loading of glycerol (80 g/L COD), and may be due to excess substrate disrupting syntrophic relationships in propionic and butyric acid-producing bacteria.

Fatty Acid Analysis in Great Lakes Fish

Rachel Runtas
Civil and Environmental Engineering

This research study analyzed the fatty acid content in fish lipid samples using gas chromatography. Three methods of derivatization, adopted from Joseph and Ackman, J.K.G Kramer, and Supelco, were tested to determine the best procedure. The derivatized samples from Ackman's method had clear spectra and 85% FA recovery; the samples from Kramer's method had clear spectra with 93% FA recovery; the samples from Supelco's procedure showed messy, unidentified peaks in the spectra with 54% recovery. The procedure from J.K.G Kramer was determined to be the best method due to its simplistic, quick, and reproducible steps that yielded accurate results. Lipid samples from GPC and lipid samples obtained from NIST Standard Reference Materials were analyzed and compared to each other and to NIST published values. For the reference fatty acid concentrations, the GPC lipid samples and SRM lipid samples showed the following fatty acids recoveries respectively; C12:0 – 190% , 225%; C15:0 – 0%, 0%; C17:0 – 113%,145%; C18:1n9t – 0%, 0%; C18:3n6 – 136%, 174%; C20:3n6 – 70%, 103%; C203n3 – 103%, 132%; C22:1n9 – 1002%, 1245%; C20:4n6 – 11% ,15%; C22:2 – 91%, 146%; C24:1 – 99% ,141%. For the certified concentrations the GPC lipid samples and SRM samples resulted respectively in: C14:0 – 148%, 197%; C16:0 – 138%, 198%; C16:1 – 124%,164%; C18:0 – 132%, 176%; C18:1n9c – 109%, 144%; C18:2n6c – 128%,165%; C18:3n3 – 265%, 196%; C20:0 – 146%, 302%, C20:1 – 122%, C20:2 – 120%, 159%; C20:5n3 – 126%, 158%; C22:6n3 – 117%, 132%. Further research is needed, such as adding an internal standard to the samples and analyzing with GC-MS, to more accurately identify and quantify the FAs.

Gaseous Mercury Fluxes: A Field Scale Empirical Model and the Development of a Controlled Lab-Scale System

Abigail Small
Thomas Holsen
Civil and Environmental Engineering

Understanding the global mercury cycle is important to limiting human exposure to the neurotoxin. Because of the large surface area covered by soils, mercury emissions from soils are considered to be an important component of the mercury cycle. However, the mechanisms controlling mercury exchange at the air/surface interface are not well known. A new empirical model of mercury flux from a coniferous soil site in the Adirondack State Park was developed. This project also explored the development of a lab-scale system that allows the experimenter to control temperature, UV radiation and ambient elemental mercury concentrations in order to explore the isolated effects of these variables on mercury fluxes. Affects of the measurement apparatus on the flux measurements posed the greatest challenge to system development.

Optimizing Aquifer Water Consumption and Maximizing Profit for Strawberry Farmers in Pajaro Valley, California

Mark Minick
X. Fu & K. Fowler
Mathematics and Computer Science

In the past decades, Pajaro Valley in California has been undergoing a severe seawater intrusion problem. As one of the major industries in the valley, berry farming, is believed to be the main cause for seawater intrusion due to its heavy use of groundwater for irrigation purpose. While the berry farmers are trying to stay profitable with the increasing water price due to additional seawater treatment, it is important and necessary to look for ways to reduce the water drafting from the endangered aquifer. In this work, we mathematical modeled an artificial berry farm with realistic parameters and constructed an optimization framework where we minimize the total aquifer draft and maximize the profits. Several methods of conservation are incorporated in the current model, including crop rotation, runoff collection, and other water conservation techniques.

Biocatalytic Microreactor of Efficient Production of Cellulosic Ethanol

Yamairy Ramos-Rivera
Chemistry and Biomolecular Science

Biomass is a renewable energy source that has received significant attention over the past several years as an alternative to fossil fuels and coal. The principal components of plant-biomass are hemicellulose, cellulose and lignin. Hemicellulose is a mixture of different sugars, mostly five carbons while cellulose is composed of glucose and hemicelluloses. The sugar present in large amounts is xylose. The goal of the project is to fabricate an efficient system for the production of ethanol from cellulosic biomass by improving the fermentation capabilities of xylose to ethanol using a microcapsule system. The specific objective of this project is to study and optimize the pH effect in the interior of the capsule and the bulk solution for ensuring maximum enzyme activity, xylose fermentation and ultimately increase the ethanol production yield. Experimental design involved pH and spectrochemical measurements using pH sensitive dyes, pH Meter and SpectroVis-Plus spectrometer to determine the pH, xylose conversion and glucose concentrations. The microcapsules contain a mixture of yeast, polymer and enzyme and are designed to increase fermentation efficiency and provide capabilities for continuous operation.

2010, REU, Dr. Silvana Andresscu, Mentor: Maryna Ornatska, PhD

The Influence of Mass Transfer on Energy Efficient Distillation Design

Brett Walker
Dr. Ross Taylor
Chemical and Biomolecular Engineering

Distillation is a process to separate compounds based on differences in boiling points; it is by far the most used separation process. Distillation columns account for approximately seven percent of the total energy consumed in the US. There are large overhead costs associated with building and testing these columns, initial design is therefore done entirely using theoretical models. In standard design procedures the model column is assumed to be operating at equilibrium. That is, the vapor and liquid phases have sufficient time to reach their theoretical maximum separation. In this work we are able to relax the equilibrium assumption and examine how the design changes when mass transfer limitations are considered. Calculations are performed both in the ChemSep software package and independently programmed. We show that mass transfer effects can have significant impacts on the optimum design, particularly in thermodynamically non-ideal systems, situations in which small amounts of a trace compound are desirable and in determining the height of the column. Mass transfer effects can both improve the design effectiveness or decrease it. However, either way the influence is important. In certain cases, neglecting the effects of mass transfer can lead to columns that cannot perform the desired separation.

Latent Cementing Properties in Rehydrated Waste Concrete

Sarah A. Marin
Civil & Environmental Engineering

This project aims to study the viability of reusing waste concrete with unhydrated cement paste as part of a new concrete mix. The old samples will be crushed and reused through a two-stage mixing approach that has proven successful in improving compressive strength of concrete. Additionally, a range of 20-30% recycled coarse aggregates will be used with 100% replacement of fines. These percentages will be kept constant, whereas the addition of new cement will be varied. The experimental findings from this research work apply to not only reuse of waste concrete from demolition but to rubble from natural disasters as well.

Impact of Historic District Designation on Housing Prices

Jason J. Altieri
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 provide conflicting results on homes that are nearby. 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.

UFPs Generated During Cooking with an Electric Stove

Yijia Zhao
Institute for a Sustainable Environment

Since airborne particulate matter (PM) has great adverse effects on human health, indoor 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)
Recently, our study is aimed to reveal ultrafine particles, emitted from different kind of cooking oils. 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 the total mass of particles. We have found that as the temperature of cooking oils increase, the total mass of particles and the percentage of black carbon increase. Thus, it is advisable for people to cook below the smoke temperature of oils.

Optical Properties of Iodine-Doped Partially Dehydrated Poly(vinyl alcohol) Thin Films

Patrick R. Kelleher
Dr. Sitaraman Krishnan
Chemical and Biomolecular Engineering

Iodine-doped uniaxially oriented poly(vinyl alcohol) films have interesting optical properties such as the polarization of visible light. We are interested in the photovoltaic properties of partially dehydrated, iodine containing, oriented poly(vinyl alcohol) films. Mechanically stretch oriented poly(vinyl alcohol) thin films were reacted with hydriodic acid (HI) vapors at 150 °C, in a still attached to a condenser and HI absorber. The reacted films were investigated using Fourier transform infrared spectroscopy (FTIR). 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 showed that the annealed films were partially dehydrated, and that conjugated polyacetylene segments were formed. Further investigation of the extent of polyacetylene formation is currently underway. These films are expected to find application in photovoltaic devices, including different types of polymeric solar cells.

Electrochemistry and Thin-film Solar Cells

Kara DiNatale
Aarti Krishna Krishnamurthy
Chemical and Biomolecular Engineering

Manufacturing of both amorphous and crystalline Si solar cells involves successive thin film deposition steps. One of these films is deliberately "doped" with small amounts of B as an impurity, increasing the electrical conductivity of Si, which is a semiconductor. Our goal is to use electrochemistry to deposit B onto Si, since electrochemical methods are simpler and more cost effective than current methods for B and Si deposition.

There are three electrochemical methods of electrochemical deposition: electroplating, electroless plating, and immersion plating. Through one of these methods I am attempting to deposit a B film onto a Si wafer with the source of the B being potassium tetrafloroborate (KBF_4), dissolved in a solvent. When a visible deposit appears on the Si surface, then this is analyzed using the EDX feature of a Scanning Electron Microscope (SEM). There have not yet been any successful tests, so further experimentation is needed.

Novel Nanocomposite Materials for Solar Cell Fabrication

Theodore Glave
Lalitha V.N.R. Ganapatibhotla , Xinli Jia, John McLaughlin, and Sitaraman Krishnan
Chemical and Biomolecular 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.

Nanostructures for Photovoltaics: Use of Block Copolymers as Templates

Bianca Garcia
Chemistry and Bimolecular Science

The use of a polystyrene-*block*-poly(4-vinyl pyridine) (PS-*b*-P4VP) block copolymer as a template for the deposition of titania (TiO_2) semiconductor, is reported. Such nanostructured TiO_2 may find use in photovoltaic applications. The preferred nanostructure for the template consists of P4VP cylinders in a thin film of PS. To obtain this morphology, specific molecular weights of PS and P4VP are required. We used Reversible Addition- Fragmentation Chain Transfer (RAFT) polymerization to synthesize PS-*b*-P4VP, and after some optimization segment sizes of 32,000 and 10,000 for the PS and P4VP, respectively, were obtained. These molecular weights were verified by nuclear magnetic resonance (NMR) spectroscopy and gel permeation chromatography (GPC) analyses. The PS-*b*-P4VP samples were spin coated onto silicon substrates. The morphologies of three PS-*b*-P4VP samples were examined through transmission electron microscopy (TEM). The optimum molecular weight ratio (32K-10K) was then exposed to titanium(IV) bis(ammonium lactate) dihydroxide; this caused titania to form in the P4VP phase, thus yielding a nanostructured TiO_2 semiconductor.

Estimating Flory-Huggins Interaction Parameter χ for Ionic and Non-ionic Polymer Mixtures

Edward Howell
Chemical and Biomolecular Engineering

An understanding of the chemical and phase equilibrium for the polymer solutions, will aid in the development of functional materials that can be used in antifouling and antibacterial applications. More specifically, a comprehension of how the polymers react under different conditions will help in design of new materials. For example, polymers used to for joint replacements should be bio-gradable; understanding how they interact with various systems such as proteins will assist in the design of less toxic materials. Flory- Huggins theory has long been used to explain the thermodynamic behavior of homopolymer and polymer blends, achieved through the determination of the Flory-Huggins χ interaction parameters. Typically these parameters are determined using group contribution methods; however for more complex and exotic polymer architectures these methods are not well developed. Ellipsometric measurement of polymer film in vapors of an organic solvent can be used to determine the value of χ. So far in our research we have designed a vessel to generate an organic vapor atmosphere and we are currently building it. This presentation will explain the steps in estimating the thermodynamics of ionic and non-ionic polymer mixtures by determination of the Flory-Huggins χ interaction parameter.

Identifying Structure-Property Correlations for Ionic Liquids

Sydney Laramie
Dr. Sitaraman Krishnan
Chemical and Biomolecular Engineering

Ionic liquids are increasing in popularity due to their desirable physical properties and their numerous applications, including use as electrolytes in dye-sensitized solar cells. Although more interest is being placed in these compounds, there is a very limited amount of data available concerning their physical properties. As it takes a significant amount of time and effort to synthesize and characterize new molecules in the lab, the ability to predict the properties of ionic liquids is very convenient. This study focused on finding structure-property correlations for the density, viscosity, and conductivity of ionic liquids. Correlations were found using Kier-Hall connectivity indices as molecular descriptors. Ionic liquids were also synthesized in the lab, examined using nuclear magnetic resonance spectroscopy and their density, viscosity and conductivity were experimentally measured. Using data gathered from the literature, a correlation was found to predict density at room temperature. Correlations were also found for the conductivity and viscosity of the ionic liquids synthesized. The correlations found can be used in the development of novel electrolytes to improve the efficiency of dye-sensitized solar cells and reduce the cost of solar energy.

Identification of Serum Protein Biomarkers for Autistic Spectrum Disorder

Melissa Butkiewicz
Dr. Costel C. Darie
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 will use 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 to ASD. Through tricine gel electrophoresis, and various staining techniques, differences between control and ASD samples exist, however the protein has yet to be clearly identified. Despite the difficulty in detecting the low molecular weight protein in gel electrophoresis, mass spectrometry will provide a definite conclusion as to whether or not the protein is, in fact, present in the samples.

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

Jennifer Sidletsky
Chemistry and 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 will be investigated. The 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. Present work includes creating unsaturated surfactants, preparing silica particles containing dye from these surfactants, and initiating radical cross-linking of the surfactants for permanent capping of the particle. Future work includes creating a biodegradable capping system for selective drug delivery. These capping systems should increase the efficacy of both the imaging and the treatment processes for cancer chemotherapy significantly.

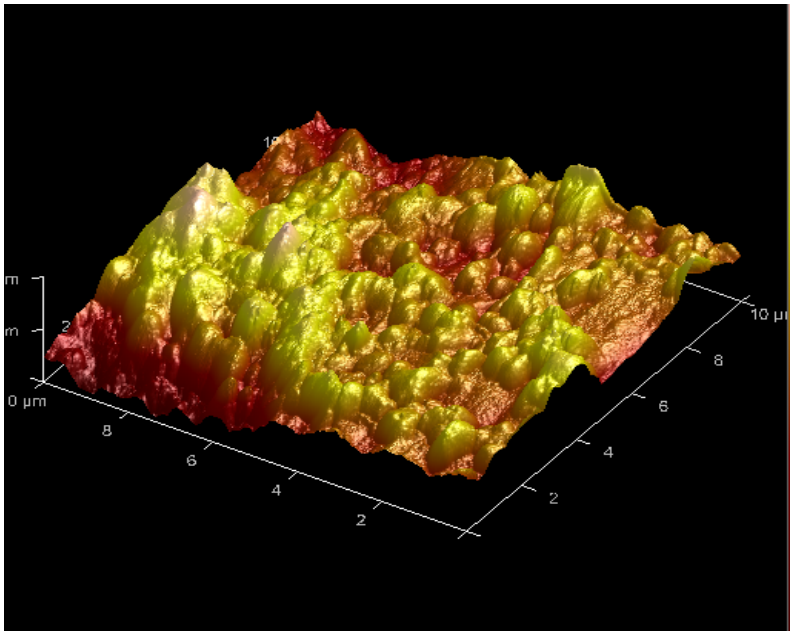
An Analysis of Topographical Features of Cancerous and Normal Cervical Cells

Andrew Cardin
Physics

The objective of the project was to help to understand the nature of the distinction between cancer and normal cells recently found on our research group. Contrary to the existing methods of cancer detection, which are typically based on the biochemical identification, our method uses only physical properties of cell surface. A distinction has been made in the non-specific (physical) adhesion properties. My research goal was to provide an explanation for the observed distinction based on the cell topography rather than adhesion.

The research consisted of an analysis of a representative sample of 50 cancerous and 50 normal (healthy) cells. The cell surface was analyzed using 35 parameters, such as maximum peak height, summit density, core fluid retention, and etc. Three ways of the analysis were studied. The first analysis was done by using the plane fitted image method. The second way was performed with the help of the Fourier transformation to remove imaging artifacts. The third analysis was carried out on the cell images corrected with a lowpass filter, which left only the smallest features of the cell surface.

The result of comparison of the values in all 35 parameters of topographical data have not yielded a distinct result separating the cancerous and normal cells as clearly as using the adhesion data. This makes the adhesion results more interesting although puzzling, because one would expect a strong correlation between topology and adhesion. Due to this result, further investigation of the cell surface will be exciting.



2014, Physics, Dr. Igor Sokolov

The Precipitation of Ni Particles

Colin Howard
Chemical and Biomolecular Engineering

The polyol method of electroless plating has been used by chemists in order to plate nanoparticles with different materials. When working with nanoparticles, electroless plating becomes much more efficient due to time and effort. Our goal is to develop refinements in the polyol methods and test whether these refinements will lead to a more efficient development of product. By changing different parameters of the experiments, we are able to find that different conditions will affect how a precipitate reacts in a polyol solution. This method has been used to successfully precipitate Co nanoparticles in a cubic crystal lattice, and also to coat Ni embryos with various precious metals. The use of electroless plating with Ni in particular however has been shown to be very difficult, due to the fact that the parameters of the experiment themselves are very delicate. Changes in order, time, and concentrations of the various chemicals all affect the final product in drastic ways, leading to a wasted product if one is not careful. Despite the difficulties, the potency of the polyol refinement can be put into a beneficial role for more effective forms of electroless plating.

Dissolution of Nanoparticles

George Apau
Emrah Ozel and Dr. Silvana Andreescu
Chemistry and Biomolecular Science

While many nanomaterials are commonly used, their interactions with biological systems as well as their environmental and health effects are largely unknown. One parameter that is believed to be related to nanotoxic effects is nanoparticle dissolution. The goal of project was to develop and optimize electrochemical methods for evaluating the dissolution of nanoparticles in an aqueous environment for further understanding the effect of this parameter on their toxicity in in-vitro and in-vivo assays. Using nickel as a model analyte, the parameters for optimizing the electrochemical measurements were examined. Electrodes coated with bismuth and gold were both tested. Under optimal conditions, good volumetric response was obtained by means of Adsorptive Cathodic Stripping Voltammetry (AdCS) at the potential of -700 to -1300 mV using the gold coated electrode. DMG (dimethylglyoxime) was used as a complexing agent to deposit the metal onto the electrode surface. Factors affecting the performance of the stripping voltammetry such as accumulation time, potential, sensitivity, and concentrations of the analyte were studied. The results of this study could be used to determine environmental and health impact of metallic nanoparticles.

A Physics Based Thermal Circuit Model for FinFETs

Paul Russell
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 FinFETs. The thermal circuit was used to generate the temperature profile along the device without the gate. When compared to finite element simulations the error was fairly small. Results are still preliminary, however, they show promise for creating an efficient model to provide accurate temperature profiles.

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.

Validity Match Score Analysis

David Yambay
Electrical and Computer Engineering

Fingerprint scanning has become a major technology in today's security market, but spoofing has grown quite common as the technology becomes prevalent. Spoof biometrics are fake personal identifiers such as a mold of a person's fingerprints used to force access into a biometric security system. A Liveness Algorithm has been designed that uses features of both live and spoof images to detect if a presented image is a live image or a spoof image.

A liveness score is generated by the program and compared against a set threshold and if the score is above the threshold the image is accepted as live and if below it is rejected as spoof. Liveness scores have been generated for the different spoof images that have been collected across a multitude of materials such as gelatin and PlayDoh. In order to validate the Liveness scores, two more scores are needed. These are the match and the quality scores.

This project analyzes the match, quality and liveness scores of the live and spoof data that has been collected on the Validity VFS 451 fingerprint reader. The purpose of which is to show the error rate of the algorithm and validate the data used to train and test the algorithm.

Testing the Validity of a Device to Monitor Activity

Matthew Ladew
Electrical and Computer Engineering

In the interest of monitoring a subject's daily activity, a device has been developed to be fit into a shoe and worn by a subject in order to collect data. This data will be analyzed to classify several physical activities, namely sitting, standing and walking. This device is currently in the process of being tested and improved, both in software and hardware. The device and analysis software will be tested for reliability by analyzing the data collected by the device and comparing the analyzed data with a standard for each test. The standards will be the result of raters independently reviewing video recordings of each test and annotating the videos with specially developed software.

Over this summer, I aided in the testing of the device and analysis software in the laboratory and the field, and in the analysis of collected data. I also developed and began to implement the software for raters to review and annotate the videos.

The reliability between the raters will be determined through statistical methods. If the raters are highly reliable, then the standard generated by the raters will be validated. If the standard is valid, it can in turn be compared to the analyzed data collected by the device, and thus validate the device and analysis software.

2011, Electrical Engineering, Honors Program, Dr. Edward Sazonov, Dr. George Fulk

Design of a User Interface for Visualization of a Patient's Activity Data

Philip Hart
Dr. Edward Sazonov & Dr. George Fulk
Electrical & Computer Engineering

A user interface (UI) to communicate results from a shoe sensor activity recognition system is designed, implemented and evaluated. The UI, consisting of a software algorithm and selected hardware components, should process and display data gathered by shoe sensors in a manner that is most user-friendly and useful for people recovering after a stroke. A goal-oriented design process is followed, with a focus on the motivations and technological aptitudes of the target user. The patients are observed to in order in order to verify hypotheses concerning their familiarity with UI technologies and the potential challenges in interfacing as a result of age and stroke-related conditions. Under direction from experts, the UI system is designed to help patients achieve their goals in using the activity recognition system by accommodating for these challenges. The cost and scalability of the system is also considered. The system is being built to meet these design criteria, and to determine the success of the design, the usability of the UI will be evaluated during an extended trial of the activity recognition system by a patient within his/her own home.

Cement Kiln Dust (CKD) Activated Fly Ash/Slag Concrete; Role of Calcium Oxide and Calcium Sulfate of CKD

Brooke Clare
Sulapha Peethamparan
Civil and Environmental Engineering

Cement manufacturing process accounts for 4-5% of global CO_2 emission and touches on a wide range of sustainability issues including climate change, pollution, solid waste land filling and resources depletion. As sustainability moves to the forefront as a major initiative for the construction industries and the society as a whole, emphasis on producing concrete mixtures with increased volume fractions of supplementary cementitous materials, such as ground granulated blast furnace slag (GGBFS or slag) and fly ash (FA). In this study, the potential of making cement free concrete binders by activating industrial by-products FA and GGBFS using another industrial by-product Cement Kiln Dust (CKD) is investigated. The performance of CKDs as activators varies widely depending on the chemical composition and the physical properties of the CKD in question. The role of the Calcium Oxide (CaO) and Calcium Sulfate ($CaSO_4$) content of the CKD in activating the fly ash and slag is investigated specifically in this work. The results show that addition of CaO and $CaSO_4$ increased the compressive strength of the CKD -activated GGBFS and FA. This alternative binding material can then be used to produce concrete. The cause of the enhanced performance will be explained using microstructural and mineralogical examinations of the activated systems.

An Exploratory Study on the Use of Phase Change Materials as a Concrete Ingredient for Effective Thermal Management of Building Indoors

Brandon A. Rivera
Civil and Environmental Engineering

Phase Change Materials (PCMs) are microscopic particles capable of absorbing thermal energy and undergoing state transformations. Due to this characteristic, PCMs have been considered to be used in building materials to reduce the amount of heat transmitted into building's interior (1). PCMs can be organic or inorganic materials, Eutectic mixtures, or Commercial PCM developed by industries. Research on different applications of these PCMs has been ongoing for the past 20 years. The concept that drives this research is during the day the external surface of buildings are exposed to solar radiation, and the building interior gets heated due to thermal conduction. This results in internal temperature increase, thereby requiring cooling to maintain occupant comfort. Dependence on air conditioning increases energy costs. Phase Change Materials when added to concrete as an integral component, have the potential to absorb portions of this thermal energy as latent heat to facilitate phase change. The energy captured by the PCM will be released during the night as the source of the thermal energy diminishes; thus returning to its solid state phase at reduced temperatures. This continuous process will maintain a constant and comfortable temperature for occupants. The use of PCM in building applications can promote energy efficiency and reduce the dependence on cooling to sustain desired room temperatures. The purpose of this exploratory study is to understand the behavior of Micronal DS 5001x and 5008x, provided by BASF The Chemical Company, when directly and indirectly integrated into concrete by various methods.

The Optimization of Diffuser Augmented Wind Turbines

Devon Jedamski
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 are 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. Figure 1 illustrates the concept. 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 product 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. Future work will include 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.

Figure 1. WindTamer DAWT at Clarkson Wind Turbine Test Site

Feasibility of a Regenerative Braking System for a School Bus

Gabrielle String
Kenneth Visser
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 being used to design a hydraulic RBS and a prototype system will be developed and tested in the lab.

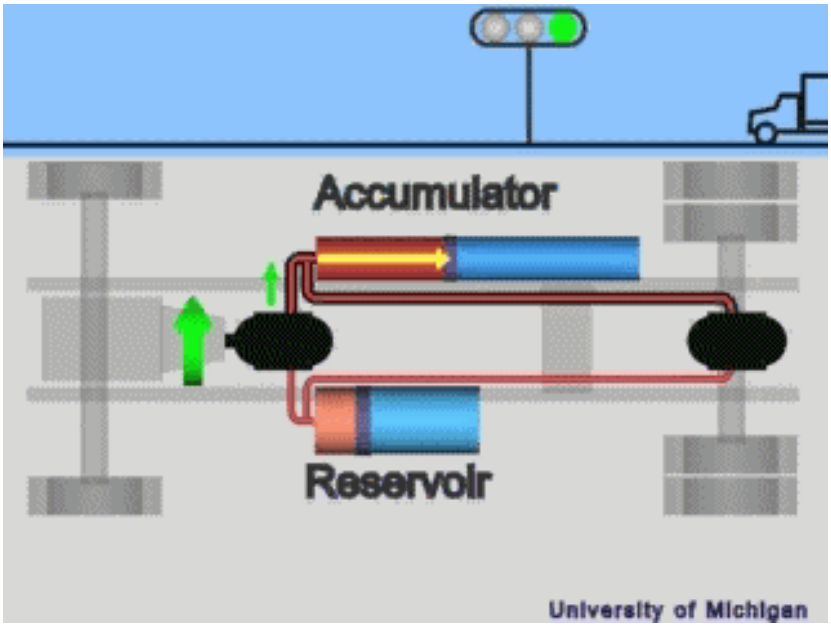


Figure 1: Parallel Hydraulic RBS

Thermal Modeling of Micro- and Nano-Scale Integrated Circuits

Ravon Venters
Mechanical and Aeronautical 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.

Computations of Flow over Circular Cylinders: Comparison to Wind Tunnel Data

James M. Callahan
Mechanical and Aeronautical Engineering

Increased focus on alternative energy generation has driven the development of a variety of new technologies. One such technology is the Compact Wind Accelerator Turbine (CWAT) being investigated by Optiwind of Torrington, CT. This design makes use of multiple small rotors on the outer edge of a cylindrical accelerator platform to maximize the energy generated from relatively low-velocity wind. In this work, the commercial CFD code FLUENT was used to analyze the flow field around the CWAT accelerator platform in both 2D and 3D. Results were compared to literature data and wind tunnel test data obtained by professor Douglas Bohl and graduate student Sumit Patel in the MAE department. Both laminar and turbulent flows were analyzed using a Reynolds Averaged Navier-Stokes (RANS) flow model. The 2D cases were used to investigate the effects of a variety of turbulence models - including the two-equation k-ε and k-ω models - as well as the effects of grid resolution on computational results. The 2D laminar results quantitatively agreed with results in the literature, while the 2D turbulent results showed weaker agreement and a large dependency on the choice of RANS model. Based on results from the 2D cases, an optimal computational method for the 3D cases was chosen. The 3D geometry was defined based on the geometry of the wind tunnel experiments, in which the cylinder length to diameter ratio was 1.6. As such the 3D results, although not analyzed yet, will be significantly different that the 2D case.

Diesel Emission Characteristics: Chassis-Dynamometer Measurements with a Light-Duty Truck

Brendan Leach
Dr. Suresh Dhaniyala
Mechanical and Aeronautical Engineering

The contribution of mobile sources to local air quality is becoming increasingly important as population studies begin to indicate a connection between their emissions and human health. Of particular importance are diesel trucks which are a major source of particulate emissions. The emission characteristics of diesel trucks (and other mobile sources) must be known to accurately determine their contribution to local air quality. For such measurements, a new chassis-dynamometer test facility was recently set up at Clarkson University. At this facility, emission measurements can be made with diesel trucks (and other vehicles) on a chassis-dynamometer system at the desired conditions of speed and engine load. Several measurements were made to determine the emission characteristics of a Chevy Duramax diesel engine under typical on-road conditions. Preliminary analysis of the obtained data suggests that the particulate and gas emissions vary greatly with vehicle speed and engine load. Further tests are planned to obtain emission characteristics during transient operation, determine the critical engine parameters that control vehicle emission characteristics, and establish the relationship between fuel type and vehicle emissions.

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

Kyle Perline
Professor Helenbrook
Mechanical and Aeronautical Engineering

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.

Nanoparticle Recrystallization

Jeremy Marshall
Dr. Ajit Achuthan
Mechanical & Aeronautical Engineering

It is known that materials with a fine-grain crystal structure (Nanocrystalline Structure) have favorable properties compared to the same materials with course-grained crystal structure. Using this knowledge, course-grained materials have been strengthened by transforming them into fine-grained materials through the Surface Mechanical Attrition Treatment (SMAT).

In this study, we will use the SMAT on a set of aluminum samples with the aim of achieving a stronger, more temperature-resistant surface. Different parameters that affect the characteristics of resulting nanostructure will be experimentally investigated.

New Fast Differential Mobility Analyzer

Jamianne Wilcox
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Differential mobility analyzers (DMAs) are widely used in aerosol research, especially in the measurement of airborne ultrafine particles (diameter < 100 nm.) Current DMA models need approximately two minutes to measure an entire particle size distribution, which can be too slow when working with aerosols under continuously changing conditions such as conditions near high-traffic roadways or under conditions of new particle formation. A new DMA, called the High Flow Dual Chamber DMA or HD-DMA, has been designed to shorten the sampling time from the previous 2 minutes to 10 seconds. This is achieved by increasing the main flow rate (sheath flow) through the instrument, increasing instrument size to accommodate high flow while maintaining a low Reynolds number and using two sampling ports instead of one. The HD-DMA has been characterized using several variations of a tandem DMA experimental setup to determine its resolution, transfer function and particle penetration efficiency. The HD-DMA was then used to sample emissions from a truck on a dynamometer.

Dynamics of a Flexible Composite Wing

Gerald Frasco
Mechanical and Aeronautical Engineering

WITHDRAWN

2014, Engineering Studies, Mechanical and Aeronautical Engineering, Peter Coffin and Dr. Ratan Jha

Diatomic Lattice Modeling of an Acoustic Metamaterial

Jeremiah Jacquier
Ajit Achuthan
Mechanical and Aeronautical Engineering

The wave propagation characteristics of a one-dimensional diatomic lattice are discussed and reviewed based upon classical wave propagation theory. Focus is on the case of different size masses comprising the lattice with equidistant periods. Of particular interest is the phenomenon of out-of-phase oscillation between the masses resulting in attenuation of a wave propagating through the lattice. The energy absorption capabilities of the lattice and the resulting presence of stop bands are discussed with emphasis on the design of acoustic metamaterials.

Characterization of Ferroelectric Thin Films Using Nano-Indentation

Roshan Das
Dr. Ajit Achuthan
Mechanical and Aeronautical Engineering

The effects of domain switching near the micro-cracks of the deposited PZT layers will be observed it and how it further damages the film. The behavior of the domain switching is to be studied under isolated residual stress conditions from the substrate. The relationships between electric displacement strain, applied electric field and stress are to be established. A nano-ECR will be used to induce a charge in the film which causes them to change the direction of polarization. The thin films are prepared using the sol-gel process and then deposited on a $Pt/Ti/Si0_2/Si$ using a vacuum spin coater.

An Investigation of Hybrid SAT solvers

Thomas Fitzsimmons
Mathematics and Computer Science

The Propositional Satisfiability Problem (SAT) is a computational problem where given a propositional formula, determine if the formula has a satisfying assignment. This problem has received a lot of attention because it is NP complete and because it is closely related to many important practical problems. Relatively fast SAT algorithms, usually called solvers, have been developed but no one solver is fastest on all formulas. This has led to the development of hybrid solvers that combine several base solvers. One example is SATzilla. This solver analyzes the input formula and attempts to choose a subset of solvers that it believes will perform the fastest on the given formula. In undergraduate research done at Clarkson University in 2009, William Garrison investigated a new hybrid approach where the input formula is reanalyzed and the choice of solver reconsidered. A prototype solver, called FragSolver, didn't prove to be competitive against some of the fastest known solvers but Garrison pointed to several possible improvements. We continued investigating this approach. We added two new base solvers to FragSolver and preliminary testing shows that the new version is not only faster than the first one but also manages to make a near-optimal choice for each input formula. Our goal for this project is to create a hybrid SAT solver that is consistently a close second to the fastest known solver.

Handling Constraints with Derivative-Free Optimization

Xiaojing Fu
A. R. Almomani, M. Minick, K.R.Fowler
Mathematics and Computer Science

Derivative free optimization (DFO) methods are designed to solve optimization problems whose gradient information is unavailable or unreliable and thus the minimization is guided solely by function values. Nelder-Mead, Genetic Algorithm, Implicit Filtering and Particle Swarm Optimization are some of the commonly used DFO methods. On the other hand, there is little guidance for DFO methods to solve problems with linear and non-linear constraints which define the feasible search region. Typical methods to handle constraints include the penalty and the barrier methods. In this study, we seek to identify the best-performing pair of DFO and constrained methods based on numerical experiments using a suite of constrained optimization test problems. Our current focus is on collecting performance measures to assess algorithm behavior based on properties of objective functions such as non-smoothness, local minima, low amplitude noise and discontinuous domains.

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

Modeling the Spread of *Porphyric Hemophilia*

Benjamin Ritz
Mathematics and Computer Science

Porphyric Hemophilia is a blood-borne disease with devastating repercussions. The infected become gaunt and pale, acquire several severe allergies, and, perhaps worst of all, lust to feed on human blood. Better known as vampires, these infected spread the disease as they feed. In response to a growing popularity of vampires in recent years, we have constructed several mathematical models which represent the spread of vampirism through a human population. These models draw heavily on both popular culture and the occult folklore regarding vampires, and may shed some light on these creatures of the night.

Image Segmentation: A Novel Approach to Identifying Cryptic Species

Valerie Bethka and Christopher Lemon
Biology
Mathematics and Computer Science

It is common practice in the field of evolutionary biology to distinguish among species based on unique physical characteristics. Regarding the lizards in the genus *Calotes*, it is often difficult to distinguish these defining characteristics visually, also known as a cryptic species complex. Given a library of images of sample lizards, we use various segmentation techniques based on partial differential equations to analyze geometric relationships and characteristics such as curvature within the image. This approach, when compared alongside DNA analyses of the sample lizards, will help develop a stronger understanding of what features can be used to determine a species within the genus.

2011, Biology/Math, UBM, Dr. James Schulte and Dr. Aaron Luttman

Understanding How the Brain Detects Threats

Brian Leventhal
Mathematics & Computer Science

The focus of this work is determining the architecture representing how the brain detects threats. Previously, a model was developed containing seventeen connections between different sensory, response attention, threat detector, and medial prefrontal cortex nodes for somatosensory and visual tasks. Optimization was used to fit these 17 parameters but results indicated that the model contained many undesirable local minima. This effort is to improve the model and optimal solution by considering physical constraints within the brain architecture. After calibrating the model, an analysis of variance approach will be used to determine the sensitivities of the model parameters.

Developing a Mathematical Model for a Virtual Roller Coaster

Tyler Mosher[1] and Steven Foti[2]
Physics

The MaxFlight® VR2002 is a 2-person virtual reality motion-platform which simulates the movements of a real roller coaster. This particular Virtual Roller Coaster (VRC) has two degrees of freedom which allow it to simultaneously rotate through 360° in both pitch and roll. This makes the experience more realistic, permitting the simulator to mimic thrilling ride elements such as loops, cobra-rolls and other inversions. NoLimits is a roller coaster design package which enables users to either "ride" existing roller coasters (first person view) or to custom build one to their own specifications. We have developed a method of extracting spatial data for any coaster designed in NoLimits. A three dimensional cubic spline fit to vertices data from NoLimits allows us to model any coaster, and create appropriate pitch, roll, and time data sets which can then be used to program the MaxFlight® motion simulator. Rider point-of-view video is also generated through NoLimits and can be displayed through the VRC projection system. With these data sets and video files, end users will be able to first create and then ride any coaster in the VRC. The extracted track model allows us to make theoretical predictions for the accelerations a rider would experience on both the actual ride and the virtual ride. Accelerometer data has been collected for several rides and is in good agreement with the predictions. Our ability to control the VRC allows for the future creation of virtual and interactive learning environments with customized motion.

[1] 2012, Physics, STEM Partnership Summer Research, Dr. David Wick
[2] 2012, Physics/Applied Mathematics, STEM, Dr. Michael Ramsdell

Metric Spaces, Lipschitz Continuity, Algebras of Functions and Bishop's Lemma

Ryan Northrup
Mathematics and Computer Science

Functions are versatile, mathematical objects, and many categories of functions exist due to differing function behaviors. Constant, continuous and differentiable, for example, are all common functions types whose properties differ. Comparing well-known function types to Lipschitz continuity, the rules of Lipschitz continuity are defined and visually interpreted. Analysis of functions individually is precursory, and the end goal is to classify properties of sets of function elements. The set structure is new to Lipschitz functions, and it leads to the proposed theorem. Preliminary results and the proposed theorem, Bishop's Lemma for Lipschitz Algebras, are presented.

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

Amy A. Cameron
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.

Identification of Volatile Organic Compound Emissions From Human Skin Through The Application of Two Techniques: Full Body Enclosure and Isolation of Forearm Skin

Patricia Beutel and Teresa Long
Alan Rossner
Institute for a Sustainable Environment

The human body naturally secretes volatile organic compounds or VOC's. The focus of this research was to identify if VOC's could be used as a unique means of individual identification. To one day detect a person based on their odor as they pass through a security checkpoint, or transport drugs through an airport. The method used to collect VOC's from human skin was solid phase microextraction in conjunction with full body suit and glass funnel enclosure. The full body enclosure was a modified chemical protective suit, and the funnel apparatus was simply a glass funnel fitted with a septum to allow a semi-airtight chamber for VOC collection. Analysis was performed using a gas chromatography mass spectrometer and a gas chromatograph with flame ionization detector. The peaks produced were identified and compared between individuals and the empty suit to create each individuals personal odor profile.

Stress, Race, and Gender: The Impact on Cigarette Smoking and Alcohol Use among College Students

Keisha Pierre-Lys
Psychology

There are many factors that can contribute to college students' cigarette smoking and alcohol use. The current study examined whether perceived stress, race, and gender are factors that differed by smoking status and level of alcohol consumption among college students. A sample of 825 undergraduates (age 18-24) completed a web-based survey for course credit or financial incentive. Results showed mean stress levels were marginally higher among smokers than non-smokers, as well as significant racial differences by smoking status. Non-Caucasians were more likely to be smokers than Caucasians. Gender differences were not found by smoking status. Drinking status was categorized as non- drinkers, moderate drinkers, and binge drinkers. Mean stress levels for drinking status did not differ significantly. However, significant gender differences were found such that binge drinkers were more likely to be male, and moderate drinkers were more likely to be female. In terms of race, Caucasians were significantly more likely than non-Caucasians to be binge drinkers. Non-Caucasians were more likely to be non-drinkers relative to Caucasians.

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

Caitlin Mincer
Dr. Kenneth N. Wallace
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.

Mathematically Modeling Risk Based Decision Making in Jays and College Students

Marie Rogers and Brianna Christopherson
Joshua Felch and Mike Rolleston
Biology
Mathematics and Computer Science

Blue Jays (Cyanocitta cristata) often pickup and visually scan multiple unshelled peanuts before deciding on one to take and store. Humans perform a similar process when trying to pick the best piece of produce in a grocery store; the goal being to obtain the best piece of produce while not spending hours and hours searching. Previous studies have analyzed decision making in western scrub-jays (Aphelocoma californica, a bird related to the blue jays) by comparing nut sampling data with three different decision strategies, ultimately concluding that a statistical model known as Comparative Bayes best describes the birds' strategy. In this study, we induced risk in analogous situations for blue jays and humans and mathematically modeled their behaviors to gain an understanding of how or if their strategies change while under risk. Using the models we compared and contrasted blue jays to humans to decide who can make more economical choices when presented with objects of different value while under the duration of risk: blue jays or humans.

Project-based Global Climate Change Education Curriculum Development and Workshop

Eileen Stachowski and William Armington
Dr. Susan Powers and Dr. Suresh Dhaniyala
Civil and Environmental Engineering

The 2007 IPCC Report stated with high confidence that climate change is occurring and that human induced industrial and agricultural practices are culprits of its acceleration.[1] During the first two weeks in August 2010, Clarkson University will hold a conference for selected teachers from New York State. These teachers will learn new strategies for implementing project and inquiry based climate change lesson plans into their classrooms. In preparation for this event, several changes specific to the northeastern United States and the Arctic were thoroughly researched and molded into modules. Data for these modules were acquired through databases such as NOAA, NASA, USHCN, and NCDC. Our findings show that increasing average annual temperature is a variable in the following occurrences; changing length of growing season, spreading of the Hemlock Woolly Adelgid (*Adelges tsugae)*, earlier frog calling dates, a less frequent ice-closing of Lake Champlain, a decrease in the ice out dates of local lakes, and a decrease in area covered by Arctic sea ice. These changes indicate that the regions of the Northeast and Arctic have been impacted by climate change on many levels and will continue to experience these changes if the temperature trends continue. At the conference, we will use these modules as a basis to lead teachers through developing lesson plans based off of real data and climate change indicators.

A Comparative Analysis of Waste Conversion into Oil

Dustin Nuhfer, Julia Henze, Andrew Parker, Richard Partch
Chemical and Biomolecular 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 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. Other organic waste materials were investigated as possible reactants in the formation of oil; all yielding low amounts of desired product under the moderate reaction conditions investigated. Sodium formate was reacted with sugar, coffee grounds, mattress foam, milk jugs, leaves, human hair, and others at 320°C $\pm$ 20°C and 1000 - 2000 psi in water. The oil was extracted and then analyzed using Infrared and Nuclear Magnetic Resonance spectroscopy, which indicated oil production. Quantification of product oil based on varying the amount sodium formate and reactant type was inconclusive. These results serve as reference information for comparison with oil production using higher temperatures and pressures.

Identification of Serum Protein Biomarkers for Autistic Spectrum Disorder

Melissa Butkiewicz
Dr. Costel C. Darie
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 will use 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 to ASD. Through tricine gel electrophoresis, and various staining techniques, differences between control and ASD samples exist, however the protein has yet to be clearly identified. Despite the difficulty in detecting the low molecular weight protein in gel electrophoresis, mass spectrometry will provide a definite conclusion as to whether or not the protein is, in fact, present in the samples.

SDS-PAGE to Discover Potential Biomarker

Marty LaFleur
Izabela Sokolowska
Chemistry and Biomolecular Science

The intent of this research is to compare and identify proteins within sera from prostate cancer samples and normal samples, in the hope of finding new approaches to identify serum biomarkers. To do this, our main tool will be SDS-PAGE followed by mass spectrometry on any bands of interest. We will be following an atypical procedure for SDS-PAGE, using first dimension SDS-PAGE to separate according to molecular weight. Our results showed several interesting bands among the cancer samples, not seen among the normal samples. These bands were excised, digested, and analyzed using a mass spectrometer. Further research will be necessary to accurately classify these proteins, and possibly discover a new technique to identify serum biomarkers.

Screening for Low Molecular Weight Serum Protein Biomarkers for Prostate and Cervical Cancer

Laura Zielewicz
Chemistry and Biomolecular Science

Biomarkers are molecules in the blood, bodily fluids or tissues that serve as signs for abnormal conditions or diseases. The discovery of biomarkers for prostate and cervical cancer would lead to advancements in the medical world by providing a biochemical method of early detection and diagnosis of the cancers. Tricine gel electrophoresis and blue native electrophoresis are used to digest, separate, and compare proteins to screen for biomarkers in prostate and cervical cancer serum samples. Tricine electrophoresis is also used to separate and compare proteins in serum samples from before and after the cancerous prostate was removed. The results show a clear difference in the low molecular weight range between the normal and cancer serum samples. Differences were also found in the low molecular weight range between the serum samples from before and after the cancerous prostate was removed. Further analysis via spectrometric methods must be completed in order to identify these proteins and clarify their reliability as biomarkers.

Photochemical Reduction of Fe^{3+} in Organic Environment

Pinguang Yang
Chemistry & Biomolecular Science

Iron plays an important biological role in biology and environment. Easy conversion between the oxidation states of iron is fundamental for catalyzing a plethora of biochemical redox processes. Our purpose of the project is to study reduction of Fe^{3+} to Fe^{2+} by chemical photochemical reduction of Fe^{3+} in organic environment.

The process of reduction is followed by measurement of concentration of Fe^{2+}. For spectrophotometric determination of Fe^{2+} we use bipyridine and BHT ligand to determine the concentration of Fe^{2+} and total concentration of iron cation respectively. We draw the calibration curves of iron by measuring the optical density of a series of standard solutions.

We simulate the reduction system of Fe^{2+} in human body by using NADH, FMNH2 and ascorbate. We found that FMNH2 and ascorbate in stoichiometric amounts but not NADH reduce Fe^{3+} to Fe^{2+}. Catalytic amounts of FMNH2 and ascorbate in the presence of stoichiometric amounts of NADH do not produce a catalytic cycle for reduction of iron cation.

In the photochemical reduction, we use carboxylic acids with pH 7.4. Experiments prove that lactic acid is the best photo-reducing reagent. We measure the rate of reduction with increasing concentration of acid and sunlight exposure to seek optimum condition.

Biocatalytic Alginate Microreactors for Simultaneous Isomerization and Fermentation of D-xylose for Fuel Ethanol

Christopher McKinney
Chemical and Biomolecular Engineering

Current industrial scale ethanol production is almost exclusively through fermentation of corn starch-derived glucose (a 6-carbon monosaccharaide), and thus cannot meet current liquid fuel needs. Alternatively, approximately 70% of plant-derived biomass is comprised of polysaccharides in the form of cellulose and hemicellulose, from which more monosaccharaides can be derived. Up to 40% of the additional monosaccharide are D-xylose, a pentose sugar that cannot be fermented efficiently by conventional yeast technology. This research focuses on isomerization of D-xylose to its fermentable isomer D-xylulose with the enzyme D-xylose isomerase, and with simultaneous fermentation using standard baker's yeast, *S. cerevisiae*. Previous research in Christiansen's labs indicates that this method has potential, but has some problems to overcome. Alginate encapsulation was used in conjunction with both batch and flow systems in the hopes of addressing problems associated with pH, enzyme equilibrium, and high enzyme cost, among other issues. Reasonable xylulose fermentation rates have been sustained for 48 hours with yeast-containing alginate beads, however results thus far have been inconclusive. Therefore more work needs to be done to solve various issues involved with the xylose isomerization and fermentation process before this method can be deemed productive and viable.

Iron Removal from Ferritin by Selective Iron (III) Chelators

Anthony Gebo
Artem Melman
Chemistry and BioMolecular Science

Iron overload disorders are increasingly common among the world's population. Excessive iron can be removed from patients by chelation using iron(III)specific chelators such as deferoxamine (DFO), 2,4-bis(hydroxyamino)- 1,3,5-triazines (BHT), and deferasirox (DFX). Since a large part of iron is stored in the form of ferritin, the release of iron from ferritin by iron chelators is an essential factor determining the efficiency and side effects of iron therapy. The current project involved studying the release of iron from ferritin by DFO, BHT, and DFX chelators , as well as the influence of other factors such as the presence small chelate ligands and oxygen on rates of iron release. We are trying to determine the relationship between the structure, physical and chelating properties, and the ability of mobilization of iron from ferritin. By distinguishing these relationships, the hope for a more effective treatment may be found.

Small chelate ligands such as hydroxamates or catechols can easily pass through the hydrophilic channels in the protein shell of ferritin and carry iron cations outside; however, these chelate ligands cannot produce stable iron complexes themselves. The role of oxygen is also essential in the process of iron release causing superoxide anion as intermediate, which can substantially facilitate iron release. Both of these processes were monitored by kinetic studies of iron release from both human recombinant ferritin using DFO and DFX with and without small chelate ligands and oxygen.

Results of our experiments indicate that BHT ligands, at concentrations in high micromolar concentrations, are capable of iron release from human recombinant ferritin, which has a similar composition as the ferritin in heart cells. The rate of iron release from horse spleen ferritin was considerably lower. Small iron chelate ligands under physiologically relevant concentrations did not appreciably increase the rate of iron release. In contrast, presence of oxygen and hydrogen peroxide considerably increased rate of iron release. These results demonstrate the importance of oxygen for the process of iron release from ferritin that will help to find more effective treatment for iron disorders.

Synthesis of Electrically Conducting Block Copolymers

Victoria L. Vasso
Chemistry and Biomolecular Science

Electrically conducting polymers are of significant interest for use in various applications, including organic light emitting diodes and photovoltaic devices. Regioregular polythiophenes in particular have been examined for such applications over the past two decades. Various methods for synthesizing polythiophenes have been developed, but one of the more common methods involves Grignard metathesis. This reaction process allows for the synthesis of polythiophenes with predictable molecular weights and narrow molecular weight distributions. Furthermore, polymers with specific functionality at the chain-end can be made using Grignard metathesis. We have been able to synthesize allyl-functionalized poly(3-hexylthiophene) with narrow and reproducible molecular weight distributions. We aim to use this functionalized polymer to create a block copolymer consisting of poly(3-hexylthiophene) and poly(ethylene glycol) which may be used as a template in the formation of a semiconductor/conducting polymer solar cell.

Degradable Polyanhydrides from Thiol-Ene Polymerization

Gwendolyn T. Burkey
Chemistry and Bimolecular Science

Polyanhydrides are interesting and potentially very useful materials that are often able to undergo surface erosion. While polyanhydrides can be made via traditional step-growth condensation polymerization and chain growth radical polymerization, new methods of polyanhydride syntheses need to be developed in order to overcome limitations in existing synthetic methods and provide flexibility in adjusting physical and chemical properties. Thiol-ene polymerization is an excellent method of polymer synthesis. This method is a radical-mediated step-growth polymerization, and is quick and easy to perform. Our group has recently shown that thiol-ene polymerization can be used to synthesize polyanhydrides. However, new thiol-ene monomers, particularly those containing anhydride groups, should be made in order to broaden the properties of the final polymer materials. This paper will present the synthesis of novel thiol-ene monomers and their use in the production of degradable polyanhydrides.

2011, Chemistry, Dr. Devon Shipp

Analysis of First Trial Response to Linear Perturbation

John Huss[1], Frank Hensing[2], and Kathryn Kearns[3]
Jeff Taylor[4] and Charles Robinson[5, 6]

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Determining how an individual responds to a perturbation is valuable in attempting to assess their risk of suffering a fall. While a great deal of research has been done in this area, most studies follow the traditional format in which a single client is run through multiple trials and their response is averaged. However, analysis of individual trials revealed that clients became entrained within one to five trials as they physically prepared for the subsequent perturbation. The goal of the current study was to perform a thorough analysis of the clients' responses to the first perturbations, as this would represent the most natural response. To induce a perturbation, individuals stood on a SLIP-FALLS sliding platform and were subjected to a 4 mm anterior move at 100 mm/s^2 for super threshold trials, and a 50 mm anterior move at 1000 mm/sec^2 for super super threshold trials, a range known to be perceivable by all study subjects. Sway was assessed by measuring the change in anterior-posterior center of pressure. Muscular response was determined in the tibialis anterior, gastrocnemius, and soleus. It was found that the tibialis anterior and gastrocnemius are both involved in center of pressure corrections of the type tested in this study, while soleus is not. This study paves the way for studies of multiple trials, which are currently underway.

2013 Mechanical Engineering, Center for Rehabilitation Engineering Science and Technology, Dr. Charles Robinson

Assessment of Latency in Response to Linear Perturbations

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Given the significant financial and social impact of falls in society, understanding how an individual responds to perturbation is critical to assessing their fall risk. When an individual is subject to a translational perturbation, there are multiple levels of response. Initially, there will be a change in their center of mass resulting from the perturbation. This will be followed by both a muscular response to reestablish the center of mass and a conscious perception of the change in center of mass and/or the muscular response. The aim of the current study was to assess the latency in change in center of mass, muscular response, and conscious perception. Populations of varied sex and age were assessed, in addition to mature diabetic individuals. To induce a perturbation, individuals stood on a SLIP-FALLS sliding platform and were subjected to a 50 mm anterior move at 1000 mm/s^2, a range known to be perceivable by all study subjects. Changes in center of mass were determined from changes in the subject's anterior-posterior center of pressure. Onset of muscular response was assessed by measuring the electromyograms of the tibialis anterior muscles. Perception latency was assessed by having subjects press a button when they detected a movement. Clients from all populations were similar in that their anterior-posterior center of pressure changes and tibialis anterior EMG changes exhibited a very short response latency (~200 ms). Button press latencies averaged 506 msec. Moreover, these latency metrics exhibited a positive correlation with age. Other relationships will be discussed.

2012 Mechanical Engineering, Center for Rehabilitation Engineering Science and Technology, Dr. Charles Robinson

Assessment of Physical Accommodations to Repeated Linear Perturbation

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Determining how an individual responds to a perturbation is valuable in attempting to understand how different populations will respond to an event that may result in a fall. The standard method of assessing response is to subject a client to repeated perturbations such that their response can be averaged. However, it has been observed that clients significantly modify their response to the perturbation within a few trials as they physically prepare to resist the perturbation. Understanding the nature of these accommodations is critical in determining the legitimacy of the data gathered in repeated trials. In the current work, data from the first three trails of a superthreshold perturbation were compared (superthreshold involved an anterior perturbation of 4 mm at 100mm/s^2 – a movement easily detectable by all clients) as well as three trials of a supersuperthreshold perturbation (an anterior perturbation of 50 mm at 1000mm/s^2). To assess changes in the clients overall center of mass, the anterior-posterior center of pressure was determined. Muscular response to the movement was noted primarily by the response of the tibialis anterior and gastrocnemious. It was found that the most reliable and consistent accommodation was a shift in center of pressure anteriorly – into the movement. This shift was typically fully engaged by the second trial, and was approximately half of the maximum change in center of pressure during the initial perturbation. It was found that after the initial trial, subjects did accommodate and altered their center of pressure.

2012 Chemical Engineering, Center for Rehabilitation Engineering Science and Technology, Dr. Charles Robinson

Visual Psychophysical Acceleration Detection Thresholds to Receding Movements of a Patterned Scene as a Function of Translation Length

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The present study examined postural control in response to visual pull of a patterned scene and sought to determine acceleration thresholds for the detection of movement of the visual scene at translation lengths of 1, 4, and 16mm. Seven healthy adult subjects (ages 19-35) were tested using a two-interval alternative forced choice (2AFC) protocol. Thirty trials at each displacement were run to determine an individual's acceleration threshold using Parameter Estimation by Sequential Testing (PEST). The threshold was confirmed by 15 validation trials. Subjects stood on a TekMat that recorded changes in anterior-posterior center of pressure (APCOP). Results suggest that there may be a "pull" of one's APCOP with the same direction and similar magnitude to the displacement of the visual scene. There also appears to be an inverse power relationship between acceleration and displacement for detection thresholds.

Lower Limb Muscle Activation Patterns uring Visually Perturbed Balance in Standing Humans

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During quiet standing and in response to visual perturbation, the dynamics of postural sway and psychophysical threshold detection levels were analyzed by measuring changes in the Anterior/Posterior Center of Pressure (APCOP) under the feet and in lower limb electromyographic (EMG) activity. Six subjects were tested (ages 19 to 32) on runs of 30 trials with an additional 15 for validation, utilizing visual pull via a receding patterned screen at displacements of 1mm, 4mm, or 16mm. During the experimental procedure, subjects stood on a pressure sensitive mat with peripheral vision occluded. They were directed to choose in which of two intervals the screen moved, following a 2-Alternative-Forced-Choice (2AFC) method. In this study, the focus was on the EMG response of three specific lower limb muscles: soleus, gastrocnemius, and tibialis anterior muscles.

2010, Biology, Center of Rehabilitation Engineering Science and Technology, Dr. Charles Robinson

Laser-Induced Breakdown Spectroscopy Analysis of Obsidian Artifact Homogeneity

Jenniffer M. Estrada[1]
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The use of multi-element chemical analysis for determining the source of origination, i.e. provenance, of archaeological artifacts has shown considerable promise in studies using various modalities such as inductively coupled plasma mass spectroscopy (ICP-MS), X-ray fluorescence (XRF), and more recently laser-induced breakdown spectroscopy (LIBS). In one example of an archaeological application, there have been efforts to identify the provenance of obsidian samples from within the Coso Volcanic Field in California that contains at least 38 high-silica rhyolite domes and thus many potential sources of artifact-quality obsidian glass. Previous work to develop techniques for classifying obsidian samples using LIBS was successful for a majority of obsidian samples in the data set, but it was also observed that for a small subset of samples (7%) the source was misclassified with high-confidence. This study investigated the hypothesis that obsidian sample heterogeneity contributed to the incorrect provenance assignments in the earlier study. For identification and detection tasks using LIBS in scenarios with a potential for sample heterogeneity, the results suggest that performance may benefit from careful design of data collection to increase diversity within the data.

Developing Alternative Biometric Spoofing Techniques

Nicolas Polanco
Dr. Stephanie Schuckers
Electrical and Computer Engineering

Biometric fingerprint scanners are designed to provide improved security to numerous types of applications used within government and privately own agencies. However, it has been highly publicized that it is possible to spoof (fake) a variety of fingerprint scanners using artificial fingers. The purpose of this research proposal is to further examine a new proposed method used in creating spoof fingerprints and compare how effective/similar it is to live fingerprints. Through the use of PCB's (Print Circuit Board) and copper etching I hypothesize that a spoof finger print can be made successfully to pass of as a live print. In doing so, the challenge would no longer be how to cheat the system but how to improve it to defend it from such spoofing techniques.

Evaluation of Two MATLAB-Based Systems for Automatic Speaker Recognition

Ras Kasa Williams
Electrical & Computer Engineering

Biometrics is the science and technology of measuring and analyzing data based on physiological or behavioral characteristics; voice recognition is one major area of research in this vast scientific field. The proliferation of speech recognition systems in the commercial sector led to increased interest within the research community to advance this technology to identify individuals through this speech. Although speaker recognition systems have seen a recent push with commercial applications in ideal environments, current research aims to develop speaker recognition systems that are viable in the non-ideal environments of forensics.

In this study, we will focus on speaker recognition and how we can use automatic systems (i.e. computer programs) to objectively analyze large amounts of data in a relatively short period of time. The dataset to be used for the experiments is a set of prerecorded speech files that were collected at Clarkson University as part of a multimodal biometrics investigation funded by the Center for Identification Technology Research (CITeR). of that will be used for the experiments. The dataset consists of over 200 subjects with multiple speech files each that was recorded over a period of three years, allowing factors such as aging to be taken into account. This dataset will be analyzed using two MATLAB-based speaker recognition systems. A comparison will be made between the two systems to determine accuracy of results and whether one, or both, systems may have viable forensic applications.

Efficient FPGA Based Subtractive Synthesis Implementation

Mark McCurry
Professor Meyer
Electrical and Computer Engineering

In the past few decades musical sound synthesis has moved from analog domain to digital and software domains. Within many methods of sound synthesis, many portions of the signal can be processed independently of each other. In this case the signal could be assembled through many parallel calculations. For analog and digital domains this is a natural flow. This parallelization is particularly applicable to the subtractive sound synthesis algorithm being researched.

This research is being done to analyze the performance gains of rewriting a software subtractive synthesis algorithm onto a Field Programmable Gate Array (FPGA). The used FPGA will be the Cyclone II on the Altera DE1 board. The primary reason the specific algorithm was chosen was observed real-time performance issues when implemented in software, along with its musical characteristics.

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. A contact microphone for monitoring breathing has been constructed from a simple piezoelectric transducer and a initial algorithm has been developed to analyze the signals it produces and detect when breathing occurs. Data will be collected to test the accuracy of this breathing detection algorithm; a procedure has been developed and data acquisition and analysis software written. In this data collection breathing sounds, nasal/oral air flow, and chest expansion will be recorded while subjects do various activities of daily living. Data collection will begin as soon as IRB approval is obtained. An initial breathing detection algorithm developed for this project uses simple analysis of the power distribution of the signal based on the Short-Time Fourier Transform of the signal and does not perform with an acceptable degree of accuracy. Additional feature extraction and pattern classification methods will be employed to improve accuracy before it is tested with the data that will be collected.

Psychophysical Detection Thresholds to Short Anterior Translations in Restrained Seated Subjects

Caitlin Storey, Engineering and Management
Charles J. Robinson, CREST and ECE

The purpose of this study is to determine movement detection thresholds in relation to the vestibular system. Subjects are blindfolded to eliminate visual cues, given headphones to eliminate auditory cues, and seated restrained in a chair on a moving platform. The chair is padded to eliminate extraneous sensory cues. Test runs of 15 and 30 trials each are carried out for each displacement of 0.5, 1, 2, 4, 8, 16, and 32 mm. In each trial, subjects are required to choose in which of two intervals a movement occurred using a two-alternative-forced-choice method. Preliminary data shows lower thres-holds of detection at shorter displacements.

Linda Richards "A Born Nurse"

Falisha Gilman
Humanities and Social Sciences

Linda Richards, best known for becoming America's first trained nurse, was born July 27th, 1841 in West Potsdam, NY. The success Linda achieved throughout her career resulted from years of hard work as she proved that women did have a place in medical field. From her training at New England Hospital for Women and Children to her last endeavor of establishing specialized training for nurses in mental institutions, Linda Richards showed commitment to both the science and the art of nursing. Potsdam and St. Lawrence County take great pride in claiming Linda Richards as one of their own; she has served as an inspiration to many local nurses. In addition, Canton-Potsdam Hospital established the Linda Richards Society, which recognizes those who help others through contributions to the hospital. Material included in this presentation was developed for the Potsdam Public Museum's current exhibit, "Medical Miracles, Mysteries, and Maladies: A History of Local Contributions to the Medical Community."

Using a Cambered Auxiliary Blade to Increase the Lift and Efficiency of a Clark Airfoil

Daniel Weiner
Mechanical and Aeronautical Engineering

Today's world is becoming increasingly dependent on natural energy, and as such it is important to make our collection of natural energy as efficient as possible. This project looks into a novel way of increasing the efficiency of lift based wings for multiple purposes. It looks at adding an auxiliary blade to increase and direct the airflow over the main blade in order to increase the efficiency slightly as well as improve its ability to function and not stall at higher angles of attack. The testing phase of this project is to find how to make and position the auxiliary blade as to most positively affect the main blade. This is being researched using a computer model developed by Professor Helenbrook of Clarkson University, which runs Novier Stokes equations for every point on a grid for given time intervals. This code gives an efficient means with which to run the trials, rather than running tests in a wind tunnel testing environment. Data is still in the process of being collected and has yet to be analyzed and as such is not part of this report. It is expected that a position will be found at which larger angles of attack can be achieved and maintained, giving the ability for the wings to create more lift. The hope is that these modified wings will increase turbine blade efficiency and help to make a new, better wind turbine.

Active Flow Control on a Small-Scale Wind Turbine

Matthew Abell
Giulio Solani and Michael Moore
Mechanical and Aeronautical Engineering

Intelligent active flow control strategies can allow power to be extracted from turbines more efficiently by increasing the range of wind velocities in which the wind turbine can safely operate. To quantify the performance gains from such a system, a small-scale wind turbine has been outfitted with a blowing-type active flow control mechanism. The effects on flow separation of different blowing configurations at different positions relative to the chord and span were experimentally investigated in a down-wind configuration. The effect of active flow control systems on power output will be quantified at different wind velocities. The analysis of the data collected will allow us to determine whether or not active flow control systems can increase the performance of horizontal axis wind turbines.

Testing and Analysis of the Performance of a Virtual Impactor

Robert B. Johnson and Guan Zhao
Suresh Dhaniyala
Mechanical and Aeronautical Engineering

The mass of airborne particulate matter smaller than 10 μm (i.e., PM_{10}) is connected to adverse human health effects, and within this fraction exposure to particles smaller than 2.5 μm (i.e., $PM_{2.5}$) is assumed to have more critical health effects. A virtual impactor is used to measure these important particles by taking a sample flow of particles and accelerating them through a nozzle and then through an impaction region, where the majority of the flow (90%) is removed perpendicular to the nozzle while the remaining flow is sampled straight through a collection nozzle. Large particles, because of their larger inertia, are sampled through the collection nozzle in the minor flow, while smaller particles are removed with the perpendicular or major flow. A high-volume virtual impactor was designed for effective measurements of $PM_{2.5}$ and PM_{10} fractions and its performance must be ascertained experimentally before field deployment. The sampler's performance is determined by a series of tests using a range of particle sizes generated with a vibrating orifice aerosol generator (VOAG) and a dust-feeder. The concentrations of particles upstream of the virtual impactor and in the major and minor flows are measured using three real-time size distribution measurement instruments – two optical particle counters and an aerodynamic sizer. The data is analyzed to determine the enrichment of particle concentrations through the two stages as a function of the particle size and the results are compared with predictions. The experimental setup, data analysis approach, and the major findings of this study will be presented.

Diesel Emission Characteristics: Chassis-Dynamometer Measurements with a Light-Duty Truck

Brendan Leach
Dr. Suresh Dhaniyala
Mechanical and Aeronautical Engineering

The contribution of mobile sources to local air quality is becoming increasingly important as population studies begin to indicate a connection between their emissions and human health. Of particular importance are diesel trucks which are a major source of particulate emissions. The emission characteristics of diesel trucks (and other mobile sources) must be known to accurately determine their contribution to local air quality. For such measurements, a new chassis-dynamometer test facility was recently set up at Clarkson University. At this facility, emission measurements can be made with diesel trucks (and other vehicles) on a chassis-dynamometer system at the desired conditions of speed and engine load. Several measurements were made to determine the emission characteristics of a Chevy Duramax diesel engine under typical on-road conditions. Preliminary analysis of the obtained data suggests that the particulate and gas emissions vary greatly with vehicle speed and engine load. Further tests are planned to obtain emission characteristics during transient operation, determine the critical engine parameters that control vehicle emission characteristics, and establish the relationship between fuel type and vehicle emissions.

Experimental Characterization of a Novel Large Particle Inlet

Amanda Durrer[1], Guan Zhao[1], Yen-Yu Chen[2], Thomas Holsen[2], and Suresh Dhaniyala[1]
[1]Mechanical and Aeronautical Engineering
[2]Civil and Environmental Engineering

Increased interest in aerosol particles larger than 10 μm has arisen due to environmental concerns associated with the atmospheric deposition of such particles. Most sampling devices are geared towards particles smaller than 10 μm because of their association with human health effects. The primary objective of this project is to characterize the performance of a novel large particle inlet (LPI) that was designed to efficiently sample particles as large as 100 μm. For this, the inlet was located in a wind tunnel and particles of a desired size range were injected. Initial tests were conducted with a new particle injection system to ensure uniform concentration of particles in the tunnel. Two optical particle spectrometers were used to determine real-time particle concentrations upstream and downstream of the inlet. The details of the inlet characterization tests and comparisons of experimental results with the previously obtained numerical predictions will be presented.

Active Flow Control on a Small-Scale Wind Turbine

Giulio Soliani
Matt Abell
Mechanical and Aeronautical Engineering

Intelligent active flow control strategies can allow power to be extracted from turbines more efficiently by increasing the range of wind velocities in which the wind turbine can safely operate. To quantify the performance gains from such a system, a small-scale wind turbine has been outfitted with a blowing-type active flow control mechanism. The effects on flow separation of different blowing configurations at different positions relative to the chord and span were experimentally investigated in a down-wind configuration. The effect of active flow control systems on power output will be quantified at different wind velocities. The data collected will be analyzed enabling us to determine whether or not active flow control systems increase the performance of horizontal axis wind turbines.

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

Pushpak Jha
Mechanical and Aeronautical Engineering

Lithium polymer batteries are widely used in a variety of applications. However not much about their battery characteristics such as capacity fade, battery life and cell voltage drop are well known. Specifically these characteristics are not known when the batteries are cyclically discharged then recharged with low depth of discharges. An experimentally setup has been designed to discharge then recharge the battery cyclically using a DC motor, load inertia, some circuitry and MATLAB/Simulink. The goal of this summer was to have the setup built and working. The circuitry involved in the setup is used to regulate the torque of the motor by controlling the current. This means designing the circuit so it can auto-correct in case the actual current starts to change from the desired current. This is not a simple task. The major issue lies in being able to accurately measure bi-directional current with a relatively noise-free signal. Once that is accomplished, a proportional integral (PI) controller can be used to do the auto-correction needed. Currently we have a circuit that is mostly working but needs to be fine tuned. We hope to finish building the setup in the near future and then being to gather and analyze the data.

2011, Electrical Engineering, Honors, Dr. Kevin B. Fite

Three Lions and a Lamb: Ordering of Random Walks on a Line

Muhammed-B. Yusuf
Physics

The problem of diffusion of particles in one dimension or random walks has been one of concern and a topic of much research in many different forms for a while. The problem is defined by calculating the probability of the motion of a particle or random walker after a period of time during which the particle or random walker is allowed to move randomly a fixed number of time steps either forward or backwards during a step. Calculating probabilities is not quite a difficult thing, what becomes more interesting is when questions are asked about the interaction between multiple particles; question such as: the probability of when one particle will overtake the other, or the probability that the particle in the lead remains in the lead after a certain period of time or the particle in the last position stay in that position. The objective of my research will be to find the probability of the last particle or random walker in a group of four in a line, never crossing the particle currently at the head of the line; that is, the initial laggard of the group never becomes the leader.

2012, Physics and Computer Science, LSAMP, Daniel Ben-Avraham.

Applications in Environmental Science of Tensor Decomposition

Maggie Leung
Na Li and Carmeliza Navasca
Supported by the Institute for a Sustainable Environment and the U.S. National Science Foundation
Mathematics and Computer Science

In this presentation, we will utilize several types of tensor decomposition to analyze different types of environmental data. Tensors are generalizations of matrices, and tensor decomposition comes into play when multi-way analysis is needed. We will use PARAFAC tensor decomposition, higher order SVD, and generalized Tucker for varying environmental data ranging from industrial influences to environmental stress on organisms. We will show the efficacy of these higher order tensor data analysis methods for these varying environmental data. We interpret and apply the solutions as applicable solutions to the problem.

DNA trapped in Taylor Vortex

Padraic Cashin
Physics

We present a Brownian dynamics simulation study of a polymer molecule trapped within a Taylor vortex flow. The Taylor vortex flow can be described by a vector field sitting in the xy-plane in a reoccurring pattern. We find that the molecule can be trapped in one of two modes while within the vector field, it stretches between two separate Taylor vortexes or can be found completely inside one vortex. The molecule's elasticity allows the polymer to stretch between the centers of two vortexes and cause a stable arch between them. If the polymer becomes engulfed by a vortex, it coils in on itself and tumbles around the vortex. The trapped states are very stable and once a polymer conforms to one, it will not readily change state. The next step will be to look at the movement of the polymer under the influence of an electrostatic potential.

Modeling How the Brain Detects Unattended Threats

Kylie Drouin
Psychology

The goal of this research was to determine how the brain detects and orients attention towards threats to the body (somatic threats) using artificial neural network (ANN) modeling. The ANN simulates the functional interactions between brain areas thought to be involved in detecting and orienting attention towards threats. Nine different ANN architectures were tested, each of which represented a different functional interaction between the threat-related brain areas. Of these, only two architectures yielded good fits, where the modeled data was within one percent of the experimental data. One of these architectures involves a threat detector. The presence of a somatic threat will result in a threat detector becoming sensitized to all bodily stimuli, both threatening and non-threatening. The other architecture involves attention set, where the unexpected occurrence of a threatening stimulus results in an increased vigilance toward the threat on subsequent trials. Each of these models lead to different predictions which will be tested in future studies.

Anxiety, Loneliness, and Shyness as Predictors of Depression

Christa Harper
Psychology

The lack of close relationships in regard to depression is of concern among current researchers, as people have a need to belong. However, according to Miller and Perlman (2009), intimate friendships are far less common than in previous years. The purpose of the present research was to examine whether the psychosocial factors of loneliness, anxiety, and shyness are significantly linked with depression. College students (*N*=685) completed web-based surveys for Introduction to Psychology course credit. Many self-report scales were used such as the State-Trait Anxiety Inventory (Spielberger et al., 1970), the Center for Epidemiologic Studies -- Depression scale (Radloff, 1977), the UCLA Loneliness Scale (Russell 1996), the Anxiety Sensitivity Index (Reiss 1997) and the Cheek and Buss Shyness Scale (1981). Loneliness, state and trait anxiety, anxiety sensitivity, and shyness were significantly correlated with depression ($p < .05$). Due to intercorrelations among variables, loneliness, anxiety, and shyness were also examined as simultaneous predictors of depression in regression analyses. Loneliness and anxiety were independent predictors of depression, but shyness did not predict depression once loneliness and anxiety were controlled.

Identifying Walking Activity in People with Stroke Using a Novel Shoe-Based Sensor

Kaylene Samuels
George Fulk
Physical Therapy

Background/Purpose: One of the main goals for people with stroke is the recovery of walking ability. The purpose of this study is to determine the validity of a shoe-based sensor to detect steps in people with stroke. **Methods:** While wearing a shoe-based sensor, that measures plantar pressures and heel accelerations subjects will be videotaped as they walk for 2 minutes at comfortable and fast speeds. The steps taken will be counted from the video and compared to the steps recorded by the shoe-based sensor. **Results:** Data collection is ongoing. **Conclusions:** This novel shoe-based sensor will allow for easy monitoring of walking activity in people with stroke.

2011, Psychology, Ronald E. McNair Scholar, Dr. George Fulk

Development of a Grid Electrostatic Precipitator

Yu Ling Huang and Xinli Jia
John B. McLaughlin
Chemical & Biomolecular Engineering

In this work, results of total collected particle counts and collection efficiency of a Grid Electrostatic Precipitator (GEP) are presented. The Grid Electrostatic Precipitator consists a pre-charger, a lower section containing grid plates and saw blades, an upper section of grid plates, and a final section for ozone removal at the top. The log scale particle counts graphs are obtained through a Wide-Range Particle Spectrometer instrument which connects to the air outflow. The positive High Voltage Regulated DC power supply of up to 12 kV was applied to the saw blades. The collecting electrodes were grounded. The obtained results demonstrate collection efficiency of particles as a function of multiple parameters, including the current of the DC power supplier, inflow air velocity, internal setting rearrangement of the GEP, and variations of external air quality. This finding is advantageous for optimizing the collecting efficiency of the GEP for the purpose of purifying air quality in various applications.

Landscape Correlates to the Shedding of Antibiotic Resistant Genes and Zoonotic Enteric Pathogens by Wild White Tail Deer in Northern New York State

Richard Marshall[1, 2],
Carrie Shaffer[1], Shane Rogers[1], and Tom Langen[1]
1. Clarkson University, Center for the Environment
2. Massena Central High School

This study investigated landscape correlates to the presence and distribution of zoonotic enteric pathogens and antibiotic resistant genes (ARGs) in the feces of wild White Tail Deer as related to livestock and produce agriculture. Deer feces were collected on State and County forest lands within upstate N.Y., including the St Lawrence River Valley and Northern Adirondack State Park. *Campylobacter* spp., Salmonellae, and enterohemorrhagic *E. coli* O157 were detected in 57%, 72%, and 68% of all scat piles surveyed (n=135), respectively, but were greatest in samples collected from within the St Lawrence River Valley. Antibiotic resistant genes (ARGs), including Tet(Q), VanA, ErmB, and Sul(I), were detected in 58%, 19%, 0.74%, and 24% of all scat analyzed, respectively. ARGs were also greatest in samples collected from within the St Lawrence River Valley, with the exception of Sul(I), which was detected more often in samples collected from the Adirondack State Park. The results of this work indicate that wild deer in proximity to livestock agriculture and manure application to land harbor and shed significantly more ARGs and enteric pathogens than wild deer inhabiting regions with less intensive or nonexistent animal agriculture. These reservoirs of enteric zoonotic pathogens and antibiotic resistant genes may pose a risk to nearby produce and water quality.

Encapsulation of Yeast for the Production of Ethanol

William Roome
Chemistry and Biomolecular Science

Because shortages of fossil energy, especially oil, the United States has moved to convert corn grain into ethanol with the goal to make the nation oil independent. This food to fuel idea has reduced the U.S. oil consumption by only 1% while consuming 20% of the U.S. grains resources. Based on this the grain to fuel approach will not create oil independence nor is it sustainable because of the volatility of an agricultural product like corn. Therefore there is growing interest to develop an ethanol production system which utilizes cellulose. Cellulose is a major component of wood and in particular paper. Americans discard 4 million tons of office paper every year. This paper could be used to create ethanol if an efficient technology is available. Encapsulation of *Saccharomyces cerevisiae* yeast in alginate provides a useful tool for the production of ethanol from various substrates of fermentation. Alginate is a polysaccharide isolated from sea weed. One substrate in particular would be cellulose. The multi use capabilities of these porous yeast capsules would provide a novel and efficient technology when compared to bulk batch cultures. The beads housing the yeast can be placed in a substrate and under anaerobic conditions allowed to ferment. Once the fermentation product has formed a new substrate could be added for another round of fermentation. The purpose of this research is to develop a high school chemistry science curriculum using the principals of Alginate encapsulation and fermentation for the production of ethanol from glucose as a substrate. Ethanol production will be verified through the consumption of glucose, change in pH and production of ethanol.

Nano/Micro-scale Systems Engineering Education

Karen Cook
Mechanical and Aeronautical Engineering

This NSF-supported project is developing a new undergraduate course (Nano/Micro-scale Systems Engineering) with a strong hands-on component at Clarkson University. The need for expensive, state-of-the-art facilities and experienced support staff in teaching nano/micro-scale engineering with hands-on experience is a serious obstacle for the development and implementation of nanotechnology courses by small institutions, or institutions in remote locations. One concern with the current situation is that this impediment can seriously limit the flow of talent and knowledge from these institutions into the U.S. high-tech workplace. The RET program is to modify the course materials to develop a module on nanotechnology for a high school biology course.

The Identification of Components of Serotonin Expression, and the Application of Myeloid Peroxidase Reaction to Study Nanoparticle Exposure

Marc A. Best
Biology

Serotonin (5-hydroxytryptamine or, 5-HT) is an important neurotransmitter that is found in high quantities throughout the digestive tract. It plays a large role in intestinal regulation. This research is a study of certain components of serotonin expression in the intestine. The study focuses on the following subjects; identifying expression patterns of both serotonin transporters and receptors within the digestive system and identifying when and where serotonin endocrine cells form within the epithelium. As well, we aim to alter serotonin levels via Nanoparticle exposure and identify corresponding innate immune response using Myeloid Peroxidase reaction.

Pharmaceutical Compact Grain Size Characterization Using Ultrasonic Methods

James D. Stephens, Carson J. Smith, Michael E. Noon, Glenn Crans, C. Cetinkaya
Mechanical and Aeronautical Engineering
Chemical and Biomolecular Engineering

The microstructure of a pharmaceutical compact has a profound influence on the mechanical properties of the compact, namely Young's modulus and mass density distribution, and in turn, can critically impact a compact's therapeutic effectiveness. As microstructure characterization is thus crucial to the understanding of pharmaceutical tablet therapeutic dynamics, a technique for characterization using ultrasonic attenuation was developed. Unlike standard characterization procedures such as SEM and optical techniques, which require excessive amounts of time and often the destruction of many samples, the ultrasonic attenuation technique described in this paper is non-destructive and rapid. The microstructure characterization derived from this ultrasonic method has been validated using X-ray computerized microtomography, which serve to visually reveal the variable microstructure characteristic length scales predicted by the ultrasonic attenuation technique.

Structural and Manufacturing Design of a Research Unmanned Aerial Vehicle

Daniel Valyou and Jordan Janas
Piergiovanni Marzocca
Mechanical and Aeronautical Engineering

In order to facilitate numerous airborne research opportunities, it was proposed to build a multirole aircraft, capable of operating as either an unmanned aerial vehicle (UAV) or as an R/C aircraft as defined by the FAA. A research UAV must have sufficient payload capacity for an avionics package as well as the research payload. Such a requirement defines a UAV which has high wing loading, a large powerplant, high endurance, a robust structural design, and most importantly a low empty weight. However a UAV designed for research should have low initial and maintenance costs, as researchers often have a limited budget. To meet these design criteria novel construction materials and methods are explored, with the goal of manufacturing a lightweight UAV capable of carrying a large fuel load and payload, with a low initial cost and even lower replacement cost. Structurally this is accomplished by using a semi-monocoque structure for the fuselage and wing consisting of fiberglass and foam composite sandwich panels. In high stress fuselage areas (landing gear mounts, firewall, and wing joints) carbon fiber sandwich panels with a core of either rohacell or honeycomb are incorporated. The wing spar is carbon fiber tube, and carries through the fuselage. The design goal for the manufacturing process is to make the process as automated as possible to enable student builders to fabricate any requisite replacement parts. All fuselage, wing, and tail skins are vacuum formed in reusable female molds. All carbon sandwich panels are cut out on a CNC machine in-house to maximize dimensional accuracy and minimize waste. The wing and tail molds are CNC machined from machinable polyurethane panels. The fuselage molds are fiberglass castings of a CNC machined fuselage plug. Maximizing the use of reusable female molds and CNC cut parts facilitates the fabrication of replacement parts and subsequent UAVs at low cost.

Can the Human Heart Provide a Means for Identity Recognition

Greta Collins
Owen Manley and Dr. Stephanie Schuckers
Electrical and Computer Engineering

Biometrics refers to the automatic identification of a person based on either anatomical or behavioral characteristics. Biometrics has gained prominence in identity management within government and commercial sectors. Thoracic biometrics are specifically those that refer to the mechanical and electrical signals of the heart as well as heart sounds. Research groups have targeted potential thoracic biometrics including heart sounds, electrocardiogram, and laser Doppler vibrometry. This is an area where more research is needed to explore the uniqueness of these potential identifying thoracic biometrics. The more traditional biometrics such as face, iris, and fingerprints can be strengthened with the use of thoracic biometrics, both in terms of improved performance as well as reduced risk of fraud. The goal of this research is to run a small data collection to obtain preliminary data including heart sounds in combination with ECG from several subjects synchronized with each other. From there we will analyze and determine if there is evidence of uniqueness in the thoracic measurements that could potentially lead to identity recognition. This research is especially important in the intelligence and security environment. Heart sounds and electrical signals are something that could potentially be measured from a distance if the face and iris were concealed. It is important we continue to study biometrics as they continue to play a leading role in both government and commercial agencies for identity recognition and security purposes.

2012, Biomedical, University of Rochester, Dr. Stephanie Schuckers

Characterization of the Pore Structure of Porous Concrete Using Multi-fractal Descriptors

Alicia Shelvay
Civil and Environmental Engineering

Random porous media are usually modeled using simplified shapes and structures. Enhanced Porosity Concrete (EPC) is an example of a medium in which the irregularly shaped pores and complex structure greatly influence basic properties of the structure. In order to avoid simplification of the pore structure, fractal geometry was applied to the EPC specimens.

Fractal geometry examines a structure on varying scales and finds the similarity contained within. When a single pattern exists on all scales, the structure is mono-fractal. It was found that the pore structure of EPC tended to exhibit multiple patterns. When multiple patterns exist over different scales, multi-fractal analysis can be used to describe the structure. Multi-fractal analysis has the ability to characterize the variability and heterogeneity of the studied object.

In this work, multi-fractal analysis was performed on binary images obtained from EPC specimens of varying composition. Multi-fractal analysis involves the formulation of three major functions: $f(\alpha)$ vs. α, $\tau(q)$ vs. q and $D(q)$ vs. q. These functions can characterize heterogeneity, complexity and detect changes in local porosity. These descriptors were used to describe the pore structure of EPC.

It was found that these descriptors provided an excellent way to describe the irregularities present within the pore structure. Multi-fractal descriptors allow for a quantitative way to describe complexity. It was found that the multi-fractal descriptors have a good relationship with basic pore structure features. In the future, the multi-fractal descriptors can be used to provide a more accurate model of the pore structure of EPC.

The Effect of Age on Vestibular Acceleration Threshold Detection Sensitivity in Seated Subjects Undergoing Subtle Anterior Translations

Daniel Brouwer[1], Xiaoxi Dong[2], Caitlin Storey[2], Dr. Ron Tavernier[3] and Dr. Charles Robinson[2]

1- Albany School of Pharmacy, 2 – Center for Rehabilitation Science, Engineering & Technology, Clarkson University, 3 – SUNY Canton

This study determined the detection threshold of the vestibular system for linear acceleration. We also tested whether the threshold varied with age. Ten test subjects were tested, five above the age of 30 and five below. Subjects were tested on runs of 30 and 15 trials for displacement moves of 0.5, 1, 2, 4, 8, 16, and 32mm. To eliminate other senses that would cue the subject to movement they were blindfolded, given headphones playing white noise, and seated in a padded restraining chair on the moving platform. During the trials subjects were forced to choose between two intervals, one during which a movement occurred. Preliminary data shows that the subjects have a lower threshold of detection when the displacement is shorter. No age effect was found.

2015, Pharmacy, Pharm. D., Jeanine Abrons