

14th Annual Summer Symposium on Undergraduate Research Experiences (SURE)

Clarkson University
July 28, 2011
Bertrand H. Snell Hall Atrium
Rooms 112, 118, 212, 213, and 214

Table of Contents

<u>Title</u>	<u>Page No.</u>
Impact of Land-Applied Dairy Manure on Downwind Air Quality: Particulate Matter & Bioaerosols -----1 Jessica Castejilla (Oral Presentation) Dr. Shane Rogers	1
Impact of Land-Applied Dairy Manure on Downwind Air Quality: Ammonia -----2 Lisa D'Auria (Oral Presentation) Dr. Shane Rogers	2
Factors Affecting Ultrafine Particle and PM_{2.5} Emissions from Heated Cooking Oil -----3 Nnennaya Mgbo Udochu (Oral Presentation) Dr. Andrea Ferro	3
Analysis of Volatile Organic Compounds from Gas Sampling Canister using Solid Phase Microextraction Gas Chromatography -----4 Jianying (Jenny) Guan (Oral Presentation) Drs. Gregory Slack & Alan Rossner	4
The Oxidation of Bisphenol A using Advanced Oxidation Processes -----5 Tess Young (Oral Presentation) Dr. Selma Thagard	5
The Extraction of PFCs from Lake Superior Water -----6 Justin Pagano (Oral Presentation) Dr. Thomas Holsen	6
The Impact of Persulfate ISCO on Soil Organic Matter -----7 Jaliza Burwell (Oral Presentation) Dr. Michelle Crimi	7
ISCO Effects on the Geomedia Properties -----8 Marina Kamal (Oral Presentation) Dr. Michelle Crimi	8
Surfactant Enhanced Chemical Oxidation using Persulfate -----9 Gerlinde Wolf (Oral Presentation) Dr. Michelle Crimi	9

Slow Sand/Bio Sand Filtration -----	10
Siahr Siddiqi (Oral Presentation)	
Dr. Shane Rogers	
Analysis of Gridded Historical Climate Data Temperature & Precipitation Trends in the Northeast United States -----	11
Micah Broehm (Oral Presentation)	
Dr. Aaron Luttmann	
Project-Based Education to Develop Climate Change Literacy within New York State -----	12
Micah Fish-Gertz (Oral Presentation)	
Dr. Susan Powers	
The DARIES Model: Modeling Co-Digestion & Multi-Stage Digester Systems -----	13
Ian McCrum (Oral Presentation)	
Dr. Stefan Grimberg	
Making Clean Energy Cleaner: The Iron Sponge in a Digester -----	14
Colin Bronchetti (Oral Presentation)	
Dr. Stefan Grimberg	
Structural & Relational Influences on Credit Availability to Small & Micro-Enterprises in Uganda -----	15
Tarif Brown (Oral Presentation)	
Dr. Augustine Lado	
Optimization of Enzyme Crosslinking for Combined Hydrolysis & Fuel Ethanol Fermentation Applications -----	16
Daniel Horn (Oral Presentation)	
Dr. Philip Christiansen	
Early Environment & Life-History Variables: Effects on Risk-Taking Propensity -----	17
Steve Minich (Oral Presentation)	
Dr. Andreas Wilke	
Early Environment & Life-History Variables: Effects on Risk-Perception & Behavior -----	18
Amanda Sherman (Oral Presentation)	
Dr. Andreas Wilke	
Cognitive Processes Underlying the Attentional Bias towards Biological Threats -----	19
Alyssa Toia (Oral Presentation)	
Dr. Robert Dowman	
How Important is it to get Enough Rest? Use of Linear Mixed-Effects Models to Examine Correlates of Psychological Attributes -----	20
Steven Foti (Oral Presentation)	
Drs. Sumona Mondal & Tina Norton	
A Partial Weight Bearing Reminder Device for Lower-Limb Rehabilitation -----	21
Katelynn Hackett (Oral Presentation)	
Dr. Kevin Fite	

A Model to Predict Soft Tissue Effects on Elbow Stiffness	22
Alexander Landauer (Oral Presentation)	
Dr. Laurel Kuxhaus	
Rotating Flows & Accretion Disks	23
Vicky Nguyen (Oral Presentation)	
Dr. Daniel Valentine	
Changes in Vertebral Micro-Architecture due to Compression	24
Lisa Ferrucci (Oral Presentation)	
Drs. Kathleen Issen & Laurel Kuxhaus	
Validation of a Shoe Based Sensor to Identify Activity Levels in People with Stroke	25
Rebekah Bierwirth (Oral Presentation)	
Dr. George Fulk	
Impact of Audio Quality on Speaker Recognition Performance	26
Jonathan Bramsen (Oral Presentation)	
Dr. Jeremiah Remus	
An Investigation of the Thermal Conductivity of Micron Fibers	27
Andrew Cardin (Oral Presentation)	
Dr. Igor Sokolov	
Verifying Acoustic Emissions on Castlegate Sandstone	28
Deanna Hauser (Oral Presentation)	
Dr. Kathleen Issen	
DNA Translocation through a Nanopore in a Single Layered Semiconductor Membrane	29
Padraic Cashin (Oral Presentation)	
Dr. Maria Gracheva	
Visualizing Data in More Than Three Dimensions	30
Louis Racette (Oral Presentation)	
Dr. Aaron Luttmann	
A Hybrid Genetic Algorithm with Implicit Filtering for Mixed-Integer Optimization Problems ---	31
Benjamin Ritz (Oral Presentation)	
Dr. Kathleen Fowler	
Complex Networks	32
Gerald Frasco (Oral Presentation)	
Dr. Daniel ben-Avraham	
Data Mining Applications in St. Lawrence River Ecology	33
Nicholas Marshall (Oral Presentation)	
Dr. Joseph Skufca	
Modeling Two-Phase Flows with Surface Tension using the Ghost Fluid Method	34
Kyle Perline (Poster Presentation)	
Dr. Brian Helenbrook	

The Design, Fabrication & Implementation of an Actuator & Cable-Driven Mechanical Whirligig Beetle -----	35
Jill Clevenger (Oral Presentation)	
Dr. Kevin Fite	
Nano Indentation Method -----	36
Yassine Khitass (Oral Presentation)	
Dr. Ajit Achuthan	
Compression of Natural Gas as use of Wind Turbine Energy -----	37
Ian Smith (Oral Presentation)	
Dr. Kenneth Visser	
Characterization of Fatigued Induced Fractures in Aluminum Foam using X-Ray Computed Tomography -----	38
Orion Kafka (Oral Presentation)	
Dr. Kathleen Issen	
Characterization of Rad51 Expression in Cardiomyocytes -----	39
Caitlin Mincer (Oral Presentation)	
Dr. Vera Gorbunova	
Comparison of Plankton Dynamics in Nearshore & Main Channel Areas of the St. Lawrence River -----	40
Nicole Kinlock (Oral Presentation)	
Dr. Michael Twiss	
Delineating Zones of the St. Lawrence River in Support of a Two-Dimensional Ecosystem Model	41
Sarah Loftus (Oral Presentations)	
Dr. Michael Twiss	
Species Composition & Abundance of Turtles at Restored Versus Natural Wetlands in the St. Lawrence River Valley of New York State -----	42
Nychele Carley (Oral Presentation)	
Dr. Tom Langen	
Are Submerged Aquatic Vegetation a Sink for Phytoplankton in the St. Lawrence River? -----	43
Eric Slaugh (Oral Presentation)	
Drs. Joseph Skufca & Michael Twiss	
A Self-Consistent Field Model for Electrolytic Polymers to be used for Photovoltaic Applications ---	44
Veronica Corneau (Oral Presentation)	
Dr. John McLaughlin	
Portable Impedance Sensors for Detecting Endocrine Disrupting Chemicals (EDCs) -----	45
Maggie Leung (Oral Presentation)	
Dr. Ian Suni	
Modeling Energy Efficient Distillation Columns while Accounting for Mass Transfer Influences --	46
Brett Walker (Oral Presentation)	
Dr. Ross Taylor	

Effectiveness of Mathematical Models for Surface Tension Calculations in Distillation Processes	47
Kyle Hancock (Oral Presentation)	
Dr. Ross Taylor	
Drug Release Kinetics using Polyanhydrides	48
Nicole Traphagen (Oral Presentation)	
Dr. Devon Shipp	
Synthesis of Vinyl Acetate-Polystyrene Block Copolymers by using a Single Reversible Addition Fragmentation Chain Transfer Polymerization Agent	49
Lily Dayter (Oral Presentation)	
Dr. Devon Shipp	
The Synthesis of Polyimides through Thiol-Ene Polymerizations	50
Brienne Kiliman (Oral Presentation)	
Dr. Devon Shipp	
Release of Drug Models from Surface-Eroding Polyanhydrides	51
Khrystyna Dilai (Oral Presentation)	
Dr. Devon Shipp	
Cement Free Low-Embodied-Energy Concrete	52
Lenard Tran (Oral Presentation)	
Dr. Sulapha Peethamparan	
Effect of Internal Curing on Compressive Strength & Shrinkage of Alkali-Activated Cement-Free Concrete	53
Margueritte Ngami (Oral Presentation)	
Dr. Sulapha Peethamparan	
Early Age Properties of Alkali Activated Binding Materials	54
Ji Zhang (Oral Presentation)	
Dr. Sulapha Peethamparan	
Engineering Properties of Clays Stabilized with Class C Fly Ash	55
Brooke Clare (Oral Presentation)	
Dr. Sulapha Peethamparan	
Electric Vehicle Infrastructure Systems	56
Jessica Stanulevich, Bryan Davidson, Sky McDonough & Nicholas McNulty (Oral Presentation)	
Drs. William Jemison & Kenneth Visser	
Electric Vehicle Systems	57
Bryan Davidson (Oral Presentation)	
Drs. William Jemison & Kenneth Visser	
Thermal Effects on Characteristics of Single Junction Silicon Photovoltaic Cells	58
Charles McGuffey (Oral Presentation)	
Dr. Ming-Cheng Cheng	

The Functionality of Electric Vehicles on the Clarkson Campus -----	59
Nicholas McNulty (Oral Presentation) Dr. William Jemison	
An Introduction to the Benefits of Variable Pricing of Electricity -----	60
Chase Turose (Oral Presentation) Dr. Lei Wu	
Use of Notch Signaling Pathways in the Decision between Secretory & Absorptive Cell Fate in the Digestive System of Zebrafish -----	61
Aisha Wood (Poster Presentation) Dr. Kenneth Wallace	
Role of Notch Receptors & Ligands in the Differentiation of Secretory & Absorptive Cells -----	62
Patricia Beutel (Poster Presentation) Dr. Kenneth Wallace	
Identification of Genetic Patterns Related to Placentation in Mammals & Reptiles -----	63
Augusta Collier (Poster Presentation) Dr. James Schulte	
Applications of Image Decomposition in the Description of New Species -----	64
Annie Murphy & Adam Hellmann (Poster Presentation) Dr. James Schulte	
Introduction to Proteomics & its use to Identify Serum Biomarkers -----	65
Andrew Wegner (Poster Presentation) Dr. Costel Darie	
Fishing for Answers: The Synthesis & Study of Jagged3 Clones in a Zebrafish Model-----	66
Emily Dreisbach (Poster Presentation) Dr. Kenneth Wallace	
Nano-Physiology of Drosophila Heart -----	67
Katherine Price (Poster Presentation) Dr. Igor Sokolov	
Locking Magnetic Particles -----	68
Matthew Kahabka (Poster Presentation) Dr. Sergiy Minko	
Development & Optimization of 'Smart' Biosensors for Assessment of Different Injuries -----	69
Fiona Moseley (Poster Presentation) Dr. Evgeny Katz & Jan Halamek	
Chemoselective Preparation of Protein Conjugates -----	70
Anthony Gebo (Poster Presentation) Dr. Artem Melman	

Optimization of Enzyme Crosslinking for Combined Hydrolysis & Fuel Ethanol Fermentation Applications	71
Daniel Horn (Poster Presentation)	
Dr. Philip Christiansen	
Development of a Nanoparticle based Enzymatic Biosensor for Sensitive Detection of Dopamine --72	
Lynn Lescarbeau & Jason Hultgren (Poster Presentation)	
Drs. Silvana Andreescu, Stephanie Schuckers & Kenneth Wallace	
New Template-Assisted Techniques to Produce Superhydrophobic & Superoleophobic Surfaces --73	
Laura Zielewicz (Poster Presentation)	
Dr. Sergiy Minko	
Alkali-Activated Concrete: Alkali-Silica Reaction	74
Rose Kennedy (Poster Presentation)	
Dr. Sulapha Peethamparan	
Hydrothermal Vent Chemical Composition Available for Mining in the Presence of Tube Worms (R. Pachyphylla)	75
Erika Chin (Poster Presentation)	
Dr. Poojitha Yapa	
Graphical User Interface for a Laser induced Breakdown Spectroscopy System using Mat-Lab ---76	
Jason Hollander (Poster Presentation)	
Dr. Jeremiah Remus	
Avian & Anuran Diversity of Restored & Natural Wetlands in the St. Lawrence Valley of New York	77
Laura Barlow & Jeremy Ozolins (Poster Presentation)	
Dr. Tom Langen	
Evaluating Fence Barriers for Preventing Turtle Road Mortality	78
Cory Symonds (Poster Presentation)	
Dr. Tom Langen	
Feasibility Analysis - Utilizing Waste Resources at DANC's Rodman Landfill for Algae Biodiesel Production	79
Ryan Esposito & Daniel Hanczyk (Poster Presentation)	
Drs. Susan Powers & Michael Twiss	
Evaluation of the Sampling Bias Associated with a Capillary Flow Controller-Canister Air Sampling System	80
Jillian Brown (Poster Presentation)	
Drs. Alan Rossner & David Wick	
Understanding the Impact of Catchment Basins on Berry Farming in the Pajaro Valley	81
Jessica Burl (Poster Presentation)	
Dr. Kathleen Fowler	
Ultralight Vacuum Chambers for use in a Airship Design	82
Robert Johnson (Poster Presentation)	
Dr. Kenneth Visser	

Transient Wind Behavior Effects on Wind Turbine Power Output	83
Andrew Salisbury (Poster Presentation)	
Dr. Kenneth Visser	
Induced Drag Reduction with the Addition of Raked Tips	84
Julian Corpus (Poster Presentation)	
Dr. Kenneth Visser	
Venturi Effect Vertical Axis Wind Turbine	85
Hassan Razak (Poster Presentation)	
Dr. Pier Marzocca	
Lift Generation of an Airfoil in a Semi-Closed Pipe	86
Nateenond Supatpitak (Poster Presentation)	
Dr. Douglas Bohl	
Load Frame Fixture for Medical Ulnar Collateral Ligament Testing	87
Bubah Conteh (Poster Presentation)	
Dr. Laurel Kuxhaus	
Drag Reduction on Aerodynamic Shapes with Ground Effect	88
Brian Hilbert (Poster Presentation)	
Dr. Douglas Bohl	
Vortex-Shedding from Rectangular Plates in a Cross-Flow	89
Joseph Fremante (Poster Presentation)	
Dr. Daniel Valentine	
The Clarkson University UAV	90
Juan Gonzalez (Poster Presentation)	
Dr. Pier Marzocca	
Rotating Flows & Cylinders: A Simple Mixing Device	91
Sarah Mead (Poster Presentation)	
Dr. Daniel Valentine	
Prediction & Verification of Young's Modulus for a Composite Laminate	92
Ruisheng Wang (Poster Presentation)	
Dr. Ratneshwar Jha	
Lagrangian Coherent Structures in the Wake of an Oscillating Airfoil	93
Tancy Thomas (Poster Presentation)	
Dr. Douglas Bohl	
Early Environment & Life-History Variables	94
George Apau (Poster Presentation)	
Dr. Andreas Wilke	
Behavioral & Psychosocial Effects of Caffeine in College Students	95
Sarah Andres & Hosana Mamata (Poster Presentation)	
Drs. Sumona Mondal & Tina Norton	

Investigating the Effectiveness of Accommodative Programs Designed to Assist People with Non-Visible Disabilities: Comparing Services in High School to Those in College & the Workplace-----96

Christa Harper (Poster Presentation)

Dr. Floyd Ormsbee

Human Center of Pressure Responses to Sinusoidal Movements-----97

Kathryn Kearns (Poster Presentation)

Dr. Charles Robinson

Analyzing the Biomechanical Responses of Blindfolded Humans to Horizontal Anterior Perturbations of a Sliding Platform-----98

Frank Hemsing (Poster Presentation)

Dr. Charles Robinson

Development of a Electromechanical Actuator for a Powered Prosthetic Leg-----99

Maurice Patrick (Poster Presentation)

Dr. Kevin Fite

Medicine in Reverse: Chemistry for Binding Overdosed Chemicals-----100

Elizabeth Callow, Sean Parnett & Elizabeth Waters (Poster Presentation)

Dr. Richard Partch

Impact of Land-Applied Dairy Manure on Downwind Air Quality: Ammonia

Jessica Castejilla

Institute for a Sustainable Environment

A common practice in livestock agriculture is to fertilize crops and grasses with manure. This nutrient recovery is an important conservation measure, reducing chemical fertilizer requirements. Few studies report air quality effects of this practice; potential environmental hazards (*e.g.*, ammonia) are not well characterized. Data are needed to improve models and for development of science-based emission reduction targets to improve air quality and protect human and environmental health. Ammonia emissions, concentrations, and deposition are monitored on-field and downwind of land-applied liquid dairy manure to determine impacts of application technique on fate and transport in ambient air. Application techniques include conventional broadcasting, low-height broadcasting, and direct injection. Wind speed and direction, temperature, relative humidity, and soil moisture are also monitored. Data from the first two years of this three-year study indicate that ammonia emissions and deposition are influenced by manure application technique; conventional broadcast spreading leads to the greatest ammonia emissions flux. Results of this work will lead to an improved understanding of air quality implications of manure application for farm workers, nearby residents, and local environmental systems.

Impact of Land-Applied Dairy Manure on Downwind Air Quality: Particulate Matter and Bioaerosols

Lisa D'Auria

Institute for a Sustainable Environment

A common practice in livestock agriculture is to fertilize crops and grasses with manure. This nutrient recovery is an important conservation measure, reducing chemical fertilizer requirements. Few studies report air quality effects of this practice; potential environmental hazards (*e.g.*, particulate matter (PM) and bioaerosols) are not well characterized. Data are needed to improve models and for development of science-based emission reduction targets to improve air quality and protect human and environmental health. PM and bioaerosols emissions, concentrations, and deposition are monitored on-field and downwind of land-applied liquid dairy manure to determine impacts of application technique on fate and transport of these pollutants in ambient air. Application techniques include conventional broadcasting, low-height broadcasting, and direct injection. Wind speed and direction, temperature, relative humidity, and soil moisture are also monitored. Data from the first two years of this three year study indicate that PM may be correlated to tractor activity and soils moisture; further study is required. Size-segregated PM samples are collected for microbial cultivation and molecular analysis to measure total bacteria, *Enterococcus* spp., and *Bacteroidales*, among other organisms of concern. Bioaerosols of fecal origin have been detected, but are primarily associated with large particles of limited transport. Results of this work will lead to an improved understanding of air quality implications of manure application for farm workers, nearby residents, and local environmental systems.

Factors Affecting Ultrafine Particle and PM_{2.5} Emissions from Heated Cooking Oil

Nnennaya Udochu

Mehdi Amouei Torkmahalleh, Iman Goldasteh,
Dr. Andrea R. Ferro, Dr. Alan Rossner & Dr. Philip Hopke
Center for Air Resources Engineering and Science

Cooking appliances such as electric or gas stoves, and heated oils emit a large number of particles which contaminate the air. The fumes given off during cooking with oils produce a great number of airborne particles. These particles contribute to increasing the level of human exposure to both ultrafine particles (UFP) and fine particulate matter (PM_{2.5}). Exposure to UFP and PM_{2.5} has been associated with health effects including respiratory disease, cardiovascular disease, and cancer.

This study focuses on characterizing emission rates for several cooking oils and their impact on indoor air quality. This research project hopes to demonstrate the dependence of oil type, temperature, surface area, additives and other factors on particle emissions and resulting particle exposures to humans during frying. We will investigate these factors under a range of cooking temperatures. The particle mass emission and particle size distribution will be determined with the use of a TSI (St. Paul, MN) Model 3007 Condensation Particles Counter (CPC), and an MSP (Shoreview, MN) Model 100XP Wide Range Particle Spectrometer (WPS). We also aim to validate computation fluid dynamics (CFD) model for estimating human exposure from cooking in a residence.

Analysis of Volatile Organic Compounds from Gas Sampling Canister using Solid Phase Microextraction Gas Chromatography

Jianying Guan

Dr. Greg Slack

Dr. Alan Rossner

Institute for a Sustainable Environment

This paper discusses the analysis of volatile organic compounds (VOCs) in indoor air. Finding affordable effective ways to identify and quantify the amount of VOCs in an indoor environment is important to evaluating the sustainability of a building design. Increasingly people spend the majority of their time indoors where VOC concentrations are the highest. Chronic exposure to some indoor VOCs can cause health effects such as eye, throat and nose irritation and damage to the liver, kidney, and central nervous system. Indoor air samples often include minute concentrations of VOCs, many with concentrations in the range of parts per billion. These low VOC concentrations make detection challenging for common methods of analysis like Gas Chromatography (GC). As a result, the analytes of interest often need to be concentrated prior to analysis. Going about this method is often tedious and costly. The purpose of this project is to determine if Solid Phase Microextraction is an effective way of transferring VOCs from a standard indoor air sampling cylinder to a GC for analysis.

Oxidation of Bisphenol A using Advanced Oxidation Processes

Tess Young

Dr. Selma Mededovic Thagard

Chemical and Biomolecular Engineering

Bisphenol A (BPA) is an endocrine disrupting chemical predominantly used in the plastic industry. As a result, BPA is commonly found in surface and drinking water. Due to the time consuming degradation process of BPA by biological methods, focus has been shifted to advanced oxidation processes (AOPs). AOPs are a technology based on the in-situ production of hydroxyl radicals, environmentally friendly species with high oxidation potential. These radicals are capable of degrading a large variety of organic compounds thereby quickly producing safer byproducts.

The work presented here compares the BPA degradation efficiency using three different AOPs: Fenton's Reagent, Ultrasound, and UV/H₂O₂ process. The former reaction yields hydroxyl radicals by reacting ferrous ions and hydrogen peroxide, ultrasound thermally splits water molecules inside the cavitation bubbles into radicals whereas UV light directly dissociates hydrogen peroxide into hydroxyl radicals. Because all three AOPs degrade BPA, the goal of this study was twofold: (1) to determine the optimal conditions for achieving the maximum BPA degradation and (2) to identify the degradation by-products.

The results show that the Fenton reaction is the only AOP capable of completely degrading BPA. The reaction is usually completed within 10 minutes during which BPA breaks down to form phenol, the final degradation byproduct. Under optimal conditions and in one hour of treatment, ultrasound and UV/H₂O₂ processes degrade 30 and 35% of the initial BPA concentration, respectively. The byproducts formed in these two AOPs are similar to the ones identified in Fenton's reaction.

The Extraction of PFCs from Lake Superior Water

Justin Pagano

Xiaoyan Xia & Dr. Thomas Holsen

Civil & Environmental Engineering

Perfluorinated compounds (PFCs) are known as an emerging contaminant, meaning that they are currently not included in routine monitoring programs and may be candidates for future regulation, depending on results of research on their toxicity, health effects, public perception, and on monitoring data regarding their occurrence in the various environmental compartments. The first step in determining if regulations are needed is to identify where these chemicals are accumulating. To determine the amount of PFCs in water samples at low concentrations – on the order of ng/L – solid phase extraction (SPE) is used to remove them from a large volume of water and concentrate them into a small volume of solvent. This concentrated solution is then analyzed using Ultra Performance Liquid Chromatography/Time of Flight Mass Spectrometry (UPLC/TOF-MS). While these techniques have been used successfully to measure PFCs in river water and wastewater, they have not been tested extensively to measure PFCs in lake water, where they exist at much lower concentrations. In this project we have successfully optimized previously used methods and shown that PFCs can be extracted with recoveries of 60-100% at ng/L concentrations. We plan to use these optimized methods to extract and analyze PFCs from Lake Superior water samples as part of the Great Lakes Fish Monitoring and Surveillance Project.

The Impact of Persulfate ISCO on Soil Organic Matter

Jaliza Burwell

Institute for Sustainable Environment

In situ chemical oxidation (ISCO) is a remediation method using oxidants to treat hazardous waste site contaminants in the subsurface. Persulfate is one oxidant used for ISCO and it requires activation to generate free radicals that are able to react with and destroy the contaminants. Iron, iron with a chelating agent (EDTA), or alkaline pH are all capable of activating persulfate. Activated persulfate not only destroys the contaminants, but also has the potential to alter soil organic matter (SOM), creating dissolved organic matter (DOM). DOM may enhance post-ISCO and/or downgradient bioactivity by providing a carbon source for the microorganisms that then can be used for contaminant biodegradation.

Experimental studies were conducted to investigate the extent and nature of DOM generated using different persulfate activation approaches with three different porous media types. Standard methods were used to quantify total organic carbon (TOC) and chemical oxygen demand (COD). Additionally, extracts were performed to characterize the amount of fulvic and humic acids found in the soil after reacting with persulfate. Preliminary results show that COD generated varies with the type of persulfate activation approaches. Results will enhance our ability to design more sustainable coupled ISCO and bioremediation treatment systems.

ISCO Effects on the Geomedia Properties

Marina Kamal

Dr. Michelle Crimi

Institute for sustainable environment

In situ chemical oxidation is one of the most rapidly growing remedial technologies applied at hazardous sites for the removal of organic contaminants in soil and groundwater. It involves the introduction of a chemical oxidant, such as sodium persulfate, into the subsurface to transform groundwater contaminants into less harmful chemical species. Although ISCO has proven to be an influential technology, there is a need for identifying its effects on the geomedia properties to understand the potential long-term impacts on aquifer quality.

The objective of this research was to analyze the effects of the sodium persulfate, along with the amendments used to activate the persulfate such as Iron, EDTA, and alkaline pH on geomedia properties using a full factorial experimental design. The experiments were conducted using three different media with varying properties. Properties of interest include total organic carbon detection (TOC), cation exchange capacity (CEC), and the concentration of minerals such as iron, manganese and aluminum. The changes in these properties were investigated because they can alter subsurface geochemistry, the partitioning of metals, and long-term microbiological processes.

Results to date indicate that the different treatments affected the concentration of the iron, manganese and aluminum oxides differently in two types of the soil out of the three and changed the cation-anion exchange capacity of the soils. Also, while still in progress, the different treatments are expected to have a significant influence on the total carbon amount in the soils.

Surfactant Enhanced Chemical Oxidation Using Persulfate

Gerlinde Wolf

Institute for a Sustainable Environment

Chemical oxidation is a widely used remediation technique for the treatment of contaminated soils and groundwater's. Four common oxidants are used; permanganate, ozone hydrogen peroxide and persulfate. Oxidation techniques are often enhanced with activation of the oxidant and with a surfactant agent that helps to facilitate and speed up the oxidation process. The purpose of my research is to determine the most effective and cost efficient method of persulfate oxidation using these enhancements. My research is focusing on the treatment of soils with three different contaminants, PCE/TCE, petroleum gas products, and BTEX. Using a full factorial study I will be testing different persulfate concentrations with three types of activations and two types of surfactants at different concentrations.

The initial phase of my research includes testing the soils contaminated with PCE/TCE. Soil samples from a TCE/PCE contaminated site were obtained and calibration of machines and initial testing of soil contamination levels is being conducted. Samples are prepared using a 1:1 mass ratio with soil and water. Samples will be analyzed for contaminant degradation and persulfate concentration. TCE and PCE will be tested using a gas chromatography machine with a flame ionization detector and persulfate concentration will be tested using a spectrometry machine.

Slow Sand/Bio Sand Filtration

Siahr Siddiqi

Dr. Shane Rogers

Civil and Environmental Engineering

Biosand filtration, or slow sand filtration, is an accepted method for the production of potable water in many developed nations. Several successful examples of point-of-use biosand filtration also exist for application in developing communities globally. Two prototype biosand filtration units were constructed and explored for reduction of color, turbidity, nutrients, and fecal coliform bacteria, the preliminary results of which will be presented. A successful biosand filter design will be implemented in a developing community in Ecuador for the production of washing water and for pre-filtration of river water for improved production of potable water using clay pot filtration.

Analysis of Gridded Historical Climate Data Temperature and Precipitation Trends in the Northeast United States

Micah Broehm

Dr. Aaron Luttman

Institute for a Sustainable Environment

Gridded historical climate records (GHC) are widely used sources of high spatial resolution (≤ 10 km per grid cell) climate related information. These spatial grids are derived from weather station measurements by using algorithms based on distance and elevation. The PRISM Climate Group at Oregon State University and the Northeast Regional Climate Center at Cornell both compile separate data sets containing the Northeast United States. Here, these two data sets are analyzed using simple linear regression and Mann-Kendall techniques to reveal trends in the data. The results of these computations are searched for consistent warming, cooling, and stable trends within and between these two data sets. While these sets show similar large scale trends, there are significant inconsistencies that should be seriously considered and addressed.

Project-Based Education to Develop Climate Change Literacy within New York State

Micah Fish-Gertz

Environmental Engineering

Dr. Susan Powers (ISE) & Dr. Suresh Dhaniyala (MAE)

Continuing an existing NASA grant project in collaboration with NYSERDA, several climate change based educational modules are being written for students in elementary through high school as well as college students. These modules are based on various ideas relating to global climate change using NASA databases and models, and have been researched and developed by undergraduate students, grade school teachers and college professors. In particular, the module developed this summer and presented here is titled “Benefits of Mitigation Strategies.” Students will answer the question: “Can carbon related emissions on a global scale be reduced such that atmospheric concentration reaches a stable level of 350 ppm and the global average temperature anomaly stays below 2 degrees Celsius in 50 years?” Students will analyze the effects of reducing global fossil-fuel carbon emissions using the concept of “stabilization wedges.” Development work on this unit required that carbon emissions be projected to the year 2061, converted to concentration and integrated into a carbon mass balance to calculate future atmospheric CO₂ concentration. This provides input for the modeling program EdGCM to calculate future temperatures. Several emission reduction scenarios using differing numbers of wedges were considered. Over the next 50 years, we need to emit at least 25 million Gt CO₂ less CO₂ than projected based on our “business as past” in order to meet climate goals. Energy efficiency, alternative energy resources and reforestation comprise the 25 stabilization wedges required to adequately reduce our CO₂ emissions.

The DARIES Model: Modeling Co-Digestion and Multi-Stage Digester Systems

Ian T. McCrum

Civil and Environmental Engineering

Anaerobic digestion is a bio-chemical process that can be used to treat organic wastes such as dairy manure. In this treatment process nutrients in the manure are stabilized and made more accessible to plants, pathogen content is reduced, and methane is produced that can be used as a sustainable fuel. In addition, this treatment process significantly reduces odors thus making land application of dairy manure less controversial for surrounding communities. Digested manure is a valuable fertilizer and can reduce groundwater pollution, can reduce pathogen contamination of crops, and can reduce greenhouse gas emissions; but the digestion process typically requires a large capital investment. Recently computer models such as the Anaerobic Digester Model Number 1 (ADM1) and the Dynamic Anaerobic Reactor and Integrated Energy System Model (DARIES) have been developed to aid in the design and operation of anaerobic digester systems, but these models lack the ability to model more advanced digestion techniques such as co-digestion and two-stage anaerobic digestion systems. These more advanced systems have the potential of reducing the capital cost of a digester system and increase methane production, thereby increasing the cost effectiveness of the system. Presented here is a modified DARIES model that can be used to model co-digestion scenarios in farm scale two-stage systems, as well as in more commonly used technologies including plug flow reactor systems and completely mixed systems. The model will be validated using performance data of three laboratory studies.

Cleaning Renewable Energy: The Iron Sponge in a Digester

Colin Bronchetti
Environmental Engineering

When most people think of alternative energy, the first word that comes to mind is not usually “cow manure.” However, this is exactly what Professor Grimberg and his mentees have been working on for going on three years: a digester. The digester produces a biogas, which is a mixture of methane and carbon dioxide, through decomposing cow manure. The gas can then be burned to provide heat for a farmhouse. This lessens the need for propane and natural gases normally used for heating.

Biogas is composed of approximately 60% of methane, 40% of carbondioxide and some trace contaminants. Depending on the cows diets part of the trace contaminants may be sulfur components. Sulfur when exposed to oxygen converts to sulfate, which in water forms sulfuric acid. This compound is very corrosive. Thus sulfur removal should be achieved before biogas combustion. This can be done using an iron sponge: a layer of woodchips, coated in iron, which remove waste gases from the system by producing iron sulfate. This method of sulfur removal is cheap, and convenient for the farmer. The iron sponge will only have to be replaced once a year.

In order to maximize energy generated by the digester it would be advantageous to clean the gas without having to compress the gas. Digesters are usually operated a low gas pressures. Therefore, the chamber in which the iron sponge is kept has to be designed so that there is a minimum pressure drop in the system, as well as having the maximum amount of gas and iron being converted into iron sulfate. The goal of this research was to develop a geometric configuration of the iron sponge system that would result in effective treatment of the biogas while minimizing pressure drop within the gas stream.

Structural and Relational Influences on Credit Availability to Small and Micro-Enterprises in Uganda

Tarif Brown
School of Business

Our research explored several bank lending issues that affect credit disbursement to business owners in East Africa, which threatens the development and viability of SMEs (Small Medium-sized Enterprises.) In this study we examine how loan officers strive to balance their banks' requirements for efficiency and risk reduction in credit disbursement as well as enhancing the flow of credit to SMEs by serving as intrapreneurs. We draw on several theoretical perspectives, including organizational sociology, relationship banking, and corporate entrepreneurship to recognize how lending is practiced in commercial banks. After, we studied the role of "Microfinance institutions" in developing countries and examined how these progressive organizations foster social capital by stimulating the growth of small businesses through availing a broader menu of services to SMEs compared to commercial banks. Subsequently, we discovered a cooperative lending model that is practiced in microfinance institutions which may resolve the many issues between East African commercial banks and SMEs. This cooperative model provides micro-lending, training and networking opportunities to SMEs. As a result, self-employed entrepreneurs who participated in this program for more than a year boast of an outstanding survival rate of 93% in both Bulgaria and the Philippines. Despite testing limitations, this study sheds new light on the contextual factors affecting credit flow to SMEs in a developing country context, such as Uganda. The study was exploratory in nature rather than seeking to explicitly test theoretically-based hypotheses.

Optimization of Enzyme Crosslinking for Combined Hydrolysis and Fuel Ethanol Fermentation Applications

Daniel J. Horn

Chemistry and Biomolecular Science

Fuel ethanol production is a costly and time consuming process. The purpose of this study was to determine and enhance the effectiveness of ethanol production by utilizing crosslinked enzymes and to optimize the fermentation of sugar into ethanol. The process uses two enzymatic hydrolysis steps followed by yeast fermentation and ethanol separation. The main focus was on the development of crosslinked protein-enzymes which were reacted with a sugar solution in order to compare the crosslinked solution with a standard solution. The crosslinking procedure began when an enzyme and a protein were combined and reacted for a period of time with a crosslinking agent. The crosslinked enzymes were eventually harvested and ground to micron size. A sample of each powder was placed into a dextran solution and allowed to react for a period of six hours; once the reaction was completed, sugar analysis was conducted. The effort made to achieve enzyme particle reactive activities has resulted in the determination that crosslinking for one hour versus five hours had no significant difference in the amount of product yielded. With these results in mind, it can be concluded that crosslinking an enzyme with a protein will be more efficient in sugar production in order to efficiently produce ethanol.

Early Environment and Life-History Variables: Effects on Risk-Taking Propensity

Steve Minich^{1a}

Amanda Sherman^{2a}, George Apau^{3b}, Dr. Tom Langen^{2,4}, Dr. Joseph Skufca¹
& Dr. Andreas Wilke²

¹Mathematics

²Psychology,

³Biomolecular Science

⁴Biology

^aITiMBReaC Undergraduate Training Program

^bMcNair Scholars Program

From an evolutionary perspective, human risk-taking behaviors should be viewed in relation to evolutionarily recurrent survival and reproductive problems. In response to recent calls for domain-specific measures of risk-taking, we emphasize the need of evolutionarily valid domains. We report on a recent study designed to validate a scale of risky behaviors in domains selected from research and theory in psychology and biology, which correspond to reoccurring challenges in the ancestral environment. Behaviors were framed in situations which people would have had some chance of encountering in modern times. Our domains of risk-taking included between-group competition, within-group competition, status, environmental challenges, food selection, food acquisition, parent-offspring conflict, kinship, mate attraction, and short-term and long-term mating strategies. We examine the effects of several life-history variables and early environmental factors on an individual's risk propensity.

Early Environment and Life-History Variables: Effects on Risk-Perception and Behavior

Amanda Sherman^{1a}

Steve Minich^{2a}, George Apau^{3b}

Dr. Tom Langen^{1,4}, Dr. Joseph Skufca², Dr. Andreas Wilke¹

¹Psychology

²Mathematics

³Biomolecular Science

⁴Biology

^aITiMBReaC Undergraduate Training Program

^bMcNair Scholars Program

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

Cognitive Processes Underlying the Attentional Bias towards Biological Threats

Alyssa Toia

Dr. Robert Dowman

Psychology

The ability to detect unattended threats is an important survival mechanism. Our previous electrophysiological and computational modeling studies suggest that threats enhance the capture of attention via threat detectors located early in sensory processing. These studies also suggest that there is a threat benefit for attentional capture only when the threat is presented outside the focus of attention. This prediction was confirmed in a recent set of studies involving pictures of physical threats to the body. In this study, we tested another class of threats, namely predatory animals (snakes). A symbolic cue given at the beginning of each trial indicated the location of the upcoming picture target. For 75% of the trials, the cue correctly predicted the location of the picture target (validly cued), while 25% of the trials incorrectly predicted the location of the picture target (invalidly cued). One-half of the targets depicted snakes, and the other half depicted emotionally neutral objects. Participants determined if the picture target appeared on the left or right side of the computer screen. Each participant filled out the Snake Fear Questionnaire (SNAQ) at the end of the study. Reaction times for the snake picture targets were the same as the neutral in both the validly and invalidly cued conditions. However, the majority of subjects scored low on the SNAQ. These results are consistent with our earlier work showing that the magnitude of the perceived threat is critical in producing a threat benefit for attentional capture.

How Important is it to Get Enough Rest? Use of Linear Mixed-Effects Models to Examine Correlates of Psychological Attributes

Steven Foti

Dr. Sumona Mondal & Dr. Tina Norton

Statistics/Psychology

From a subsample of Clarkson students in an Introductory Psychology course, data was collected over the course of 8 weeks. This data included demographics such as age, gender, and class year, as well as psychosocial variables such as stress, anxiety, depression, sleep, and caffeine use. Multivariate correlation analysis displayed an interesting result, one that suggested that stress, anxiety, and depression were only related to how rested a subject felt. We found that average hours of sleep and a measure of rest were the best predictors. We were then able to create linear mixed-effects models to represent the relationships between these variables. By comparing measures of relative goodness of fit of the models, we were able to select simple models establishing important relations, without losing significant relationship information.

A Partial Weight Bearing Reminder Device for Lower Limb Rehabilitation

Katelynn Hackett
Mechanical Engineering

Lower-limb rehabilitation following total knee or hip replacement, cartilage cell transplant, cruciate ligament replacement, meniscus debridement, or complex fracture repairs often requires restricted weight bearing on the affected extremity. The technique currently used by physical therapists relies on patient recollection of the feeling of the prescribed weight restriction and is not very reliable. Patients are given verbal instruction combined with partial weight bearing (PWB) practice with a bathroom scale. Biofeedback training provides the patient with additional sensory information and improves his/her mobility awareness. The developed prototype entails shoe-embedded pressure sensors consisting of silicone tubing formed into three flat spiral coils. The coils are arranged in the high impact regions of the shoe's sole. The tubing is connected to pneumatic pressure sensors inside a small ankle attachment. The sensors interface with a micro-controller programmed to alert the user when the prescribed weight restriction has been exceeded through audible, visual, and tactile reminders. The device's performance is analyzed through static and dynamic trials to determine precision and accuracy within average weight bearing restrictions of 20-50% of body weight for the entire duration of lower limb rehabilitation.

A Model to Predict Soft Tissue Effects On Elbow Stiffness

Alexander K. Landauer
Mechanical and Aeronautical Engineering

Excessive elbow stiffness, often a complication in elbow trauma, impairs the arm. The soft tissue contributions to elbow stiffness are unquantified, as this is a challenging property to study in physical specimens; therefore, development of a computer model of the elbow and surrounding soft tissue is undertaken. This model attempts to predict individual contributions to elbow stiffness by soft tissue elements. Designed in conjunction with a physical Elbow Stiffness Tester (EST) and constructed in the OpenSim 2.3.1 biomechanics modeling software; it is based on the Delft Shoulder and Elbow Model (Figure 1) constructed by Blana *et al.* [1]. It simulates the EST by applying a variable torque at the elbow and recording the reaction during over time, with and without muscle activation. Through utilization of OpenSim's analysis toolset and a custom MATLAB script, overall elbow stiffness is calculated for each time-step. A superposition principle is applied in a piecewise fashion to determine the effect soft tissue elements on elbow stiffness. In general, it is expected that increased torqueing of the elbow and more rapid torqueing will increase stiffness, while removal of soft tissue will decrease stiffness. Results obtained by analysis of this model will be compared to measurements recorded with the EST on live human and cadaveric subjects. Future work may include refinement of the upper extremity model to improve the accuracy of the physiologic representation of soft tissue and joint dynamics.

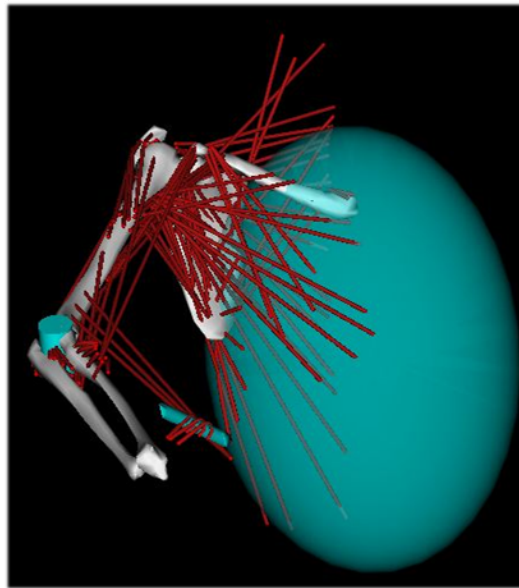


Figure 1 – The Blana *et al.* model.

[1] Blana, D., Hincapie, J. G., Chadwick, E. K., Kirsch, R. F., 2008. A musculoskeletal model of the upper extremity for use in the development of neuroprosthetic systems. *Journal of Biomechanics* 41, 1714-1721.

Rotating flows and Accretion Disks

Vicky D. Nguyen

Mechanical and Aeronautical Engineering

The motivation of this experiment explores the uniqueness of the function of accretion discs in fluid dynamical context. Accretion discs are flat circular discs that rapidly rotate gas particles around a central gravitating body. These discs manifest themselves in planet formation (proto-planetary discs), active galactic nuclei, stellar binaries, and various kinds of gamma-ray bursts. Given that accretion discs are efficient energy sources in the Universe (Balbus, 1996, p.364), its common mechanism include a combination of hydrodynamics, viscosity, turbulence, magnetic fields, gravity, and radiation. To investigate the astrophysical perspective in fluid dynamical understanding, the popular Taylor-Couette flow experiment is analyzed; see Figure 1. The angular momentum transport phenomenon is investigated in the Taylor-Couette flow experiment in order to compare it with that of accretion discs. We investigate the comparison by using numerical simulations of Taylor-Couette flows that are axisymmetric and incompressible. The results of the numerical simulations provide understanding of the angular momentum transport in the Taylor-Couette flows as well as accreting disc flows.

References

Balbus, S. A., Stone, J.M., (1996). Angular Momentum Transport in accretion disks via convection. *The Astrophysical Journal*, 464, 364.

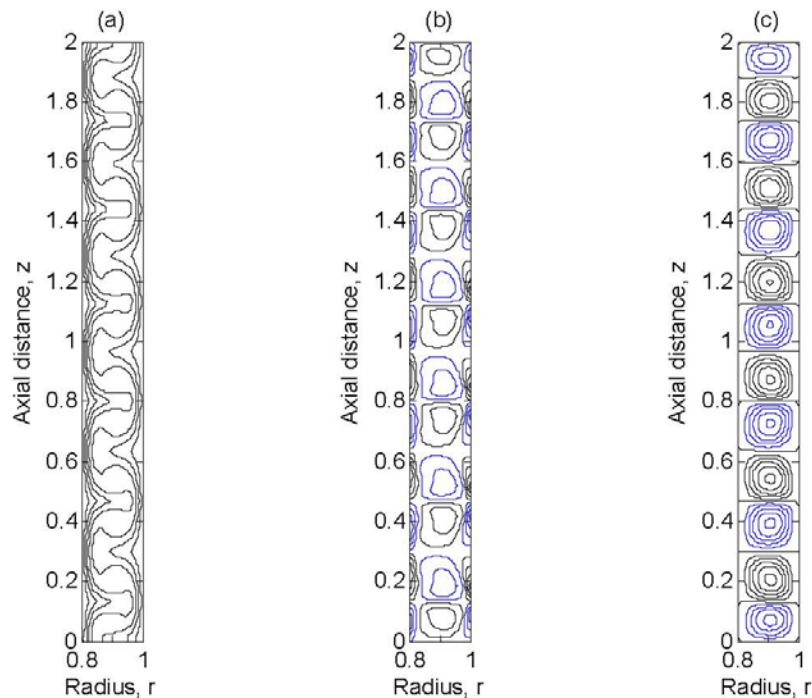


Figure 1: Axisymmetric Taylor-Couette flow pattern, $Re = 2000$. (a) Tangential component of velocity. (b) Tangential component of the vorticity. (c) Contours of stream function.

Changes in Vertebral Micro-architecture due to Compression

Lisa Ferrucci

Mechanical and Aeronautical Engineering

Osteoporosis is a major health problem affecting millions of Americans annually. This disease is the structural decline of bone which weakens the micro-architecture. This weakening can cause painful fractures and breaks leading to hospitalization. If the micro-architectural structural changes common in osteoporotic failure were understood better, patient-specific preventative measures could be developed and prescribed. To simulate compression fracture conditions, this research will compress the lower lumbar region of the spine, and then quantify strain on the cortical shell and examine the effects on the micro-architecture of the cancellous bone. Cervine vertebrae will be used for preliminary testing. This will assist with the development of accurate procedures leading to the testing of human vertebrae. Cervine vertebrae have a similar bone density to human, are readily available, and are less expensive than human vertebrae. The preliminary work will allow for the interchanging of testing equipment and predetermined loads based on the results from cervine testing. Figure 1 is one such equipment. The fixture will help with securing a testing specimen before compression. Future work will compress the vertebrae and provide a better understanding of the occurrence of fractures during osteoporosis; fractures in the cortical shell and/or within the cancellous bone. Further research can ultimately reduce the incidence of vertebral compression fracture and the associated costs.

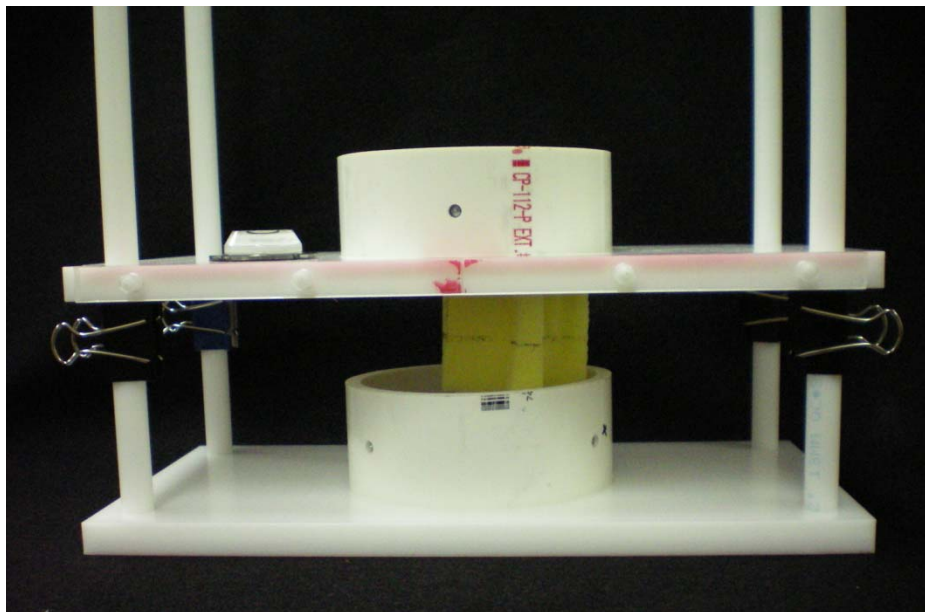


Figure 1

Validation of a Shoe Based Sensor to Identify Activity Levels in People with Stroke

Rebekah Bierwirth

Dr. George Fulk

Physical

Introduction/Purpose

Individuals who have suffered from a stroke often have difficulty maintaining the recommended activity levels to stay healthy. This system serves to validate a shoe sensors' ability to identify different functional activities in people with stroke.

Methods

The sample of participants in this study included 11 individuals with an average age of 62.7 years. The shoe sensor system was composed of an accelerometer and an insole with sensors that determined pressure distribution across the foot. An artificial neural network was employed to analyze data from the shoes sensors to determine activity levels. Data was collected in two settings; clinical community.

Data analyzed

Clinic data analysis was performed using a trained neural network that output a confusion matrix of accuracy and recall for each subject.

Community data analysis was performed using a trained neural network that output values in seconds for each activity. Data was compared to a visual assessment of how long each activity was performed for.

Results

Confusion matrices were formed for each individual subject as well as the group as a whole. Precision for this network is 0.997 and recall is 0.99.

All community data collected from the eleven subjects was entered into a comparison spreadsheet that determined the accuracy of the activity recognition system. The correlation coefficients were 0.90928 for sitting, 0.69294 for standing, and 0.76853 for walking.

Discussion/Conclusion

This activity recognition system has the potential to increase activity levels in subjects who have suffered from stroke using a high precision rate and accurate feedback measures.

Impact of Audio Quality on Speaker Recognition Performance

Jonathan Bramsen

Dr. Jeremiah Remus

Electrical and Computer Engineering

Speaker recognition has many real world applications. These benefit from a better understanding of the relationship between audio quality and speaker recognition system performance. A better understanding of how both particular noises and different room and microphone environments can affect the performance of a speaker recognition system could be beneficial. Both topics of interest will be examined during two separate experiments; one using human assessment and the second via simulation using genetic algorithms. Both experiments are currently in development. It is anticipated that human assessed quality and genetic algorithms may be reliable types of audio quality assessment.

An Investigation of the Thermal Conductivity of Micron Fibers

Andrew Cardin

Vivekanand Kalaparathi & Dr. Igor Sokolov
Physics

Understanding the thermal properties of materials is an important step to discovering potential applications of new materials. As an example, if a material has low thermal conductance it can make a good thermal insulator. Alternatively, a good thermal conductivity could be used for heat sinks. With the development of nanotechnology and new materials, the problem of measurement of thermal conductivity of small particles and fibers becomes important. Traditional methods require preparation of a microscopic sample, which is not practical for excessively small particles and fibers. Here we are described in the development of such a new method of direct measurement of thermal conductivity by using high-resolution mid-infrared (7-14 micron wavelength) camera.

The objective of this research is to measure the thermal conductivity of nanoporous silica fiber. The first step in this direction is to do a controlled experiment with a fiber of comparable size made of a known material. Nonporous solid silica is the material of choice for this kind of experiment. The direct measurements of the temperature change with time along the fibers are compared with numerical simulations, which describe the solution of heat equations. This allows us to extract the sought value of the thermal conductivity.

Verifying Acoustic Emissions in Castlegate Sandstone

Deanna Hauser

Mechanical and Aeronautical Engineering

Acoustic emission pin technology has a cornucopia of uses; for example, they record minute levels of noise, such that the location at which the noise occurred can be calculated. These devices were used to locate crack formations in sandstone, although the accuracy of this had yet to be verified. This research used a novel approach of pore imaging; previously loaded Castlegate sandstone specimens that used acoustic emission pin technology were imaged using a microCT scanner. This reconstructed data was then filtered using VGStudio MAX 2.1 and MATLAB, based on regional densities. Many of the cracks discovered in the samples have been dilation shear bands and are therefore less dense than most of the surrounding area. A second filtering process, in which a nearest neighbor criterion was applied, was required due to the amount of random voids in the sample, many of which may have been areas of porosity or scanning artifacts. The filtered data was then graphed in three dimensions to show the path of each crack through a given sample. These graphs were then overlaid with the graph of the acoustic emissions data for that specimen. Thus, the acoustic emissions data and the location of the actual bands could be compared to see if they coincided. Initial results qualitatively show that the band represented by the acoustic emissions data and the band plotted using the microCT scanner data have a reasonable correspondence. In the future, this will be quantified with plane fitting equations for both sets of data.

DNA Translocation Through a Nanopore in a Single Layered Semiconductor Membrane

Padraic Cashin
Physics

We have developed a computational model of a DNA chain, that allows us to study the effects of different electrostatic potentials on motion of the chain during electrophoresis through a nanopore in a semiconductor membrane. We use a Brownian Dynamics model to simulate a single-stranded DNA polymer (ssDNA). Each monomer of the ssDNA chain is treated as a spherical bead, which is connected to adjacent beads by a spring force. In order to prevent beads from overlapping and passing through the boundaries of the nanopore, the beads are subject to a Lennard-Jones excluded volume potential. Each bead contains an electrostatic charge, that allows us to manipulate the DNA polymer by creating additional electrical potentials within the nanopore. Depending of the nature of the potential, the ssDNA molecule can pass through the pore without obstruction or it can be captured by the nanopore. We can also change the electrolyte bias, which affects the speed of translocation, as well as the polymer's gyration radius. The nanopore consists of a cylindrical pore in a silicon semiconductor membrane which is made of a single layer of n-doped silicon material. Through these simulations, we have shown that it is possible to effect the shape and the rate of translocation of the polymer.

Visualizing Data in More than Three Dimensions

Louis Racette

Mathematics

Visualization of objects in more than three dimensions in a manner comprehensible to the human vision system is difficult at best. While several graphical models currently exist to show data in more than three dimensions, these models have not been comparatively tested or assembled into a single program. Thus, the most easily readable method for displaying high-dimensional data (dependent on both the number of dimensions used and the analysis required of this data) is not presently known. This project examines various methods used to represent n -dimensional objects (where n is an arbitrary positive integer), with the specific goal of finding the optimal presentation method for various numbers of dimensions and types of data. In order to assist with visualization and manipulation of n -dimensional data, this project involves the creation of a computer program to represent basic geometries in n -dimensional space. These representations include drawing objects using parallel one-dimensional axes, multiple two-dimensional axes, multiple three-dimensional axes, and animation methods. Each representation method would be expected to perform differently during user testing: two-dimensional models present information in a simplistic form that is helpful for distance measurements but not for visualization; inversely, three-dimensional models present information that is useful for visualization but not measurement of n -dimensional objects.

A Hybrid Genetic Algorithm with Implicit Filtering for Mixed-Integer Optimization Problems

Benjamin Ritz
Mathematics

The object of this project is to create a novel algorithm to solve $\min(F(z,x))$, where z is of the form $\{0,1\}^M$ (that is, there are M binary variables) and x is a vector in \mathbb{R}^N , with N real variables.

Genetic algorithms create a simulated population, with each individual bearing M binary values and N real values. These individuals are weighed against each other and ranked according to which give the lowest value for $F(z,x)$. The lowest-ranked individuals are deemed the “most fit,” to relate to the general evolutionary metaphor. These individuals are “bred,” creating a new generation. Randomized crossover and mutation are implemented to create a quasi-realistic population. This continues until the user-specified number of generations is reached.

Implicit filtering is a derivative-free optimization method that approximates a gradient using only function values. The algorithm follows a Newton-like method to solve the nonlinear system of equations. The accuracy of this approximation begins coarse and then becomes more accurate as the optimization progresses. This filters out any low-amplitude noise in the objective function. These methods are used in engineering design, which may require a call to a simulation; accurate approximations may model noise that comes from the simulation tool.

These methods are combined in one algorithm written in MATLAB, for user-friendliness and use with built-in solvers. This allows for increased flexibility over other code, such as the somewhat-similar EAGLS.

Complex Networks

Gerald Frasco

Physics

Complex networks can represent a wide variety of real-world models, such as cellular structure, international flight paths, or website domains. What I will be looking at in particular are social networks. Each person can be represented as a node, and when two people share friendship they have a connection. The first step was building the network. When a new node is placed, it will connect to another node with probability $1-r$ and connect to that node's ancestor with probability r , where $0 \leq r \leq 1$. How the value of r affected the degree distribution was then examined. The produced network was also compared to network theory. Geographic distribution was then looked at. A new node was placed at a distance corresponding to a powerlaw distribution. This proved to be fractal. The fractal dimension was then looked at, especially its relation to both r and α .

Data Mining Applications in St. Lawrence River Ecology

Nicholas F. Marshall

Anthony M. Harvey, Nicole Kinlock, Sarah Loftus,
Dr. Joseph D. Skufca & Dr. Michael R. Twiss

Mathematics

Data mining techniques were used in accordance to two river ecology applications: creating a predictive model for E. coli and eliminating outliers in dilution assay data. We tested the hypothesis that upstream water sampling could provide a better prediction of E. coli levels at beaches on the St. Lawrence River. Currently, the assessment of bathing safety is based off previous day beach E. coli counts. This is a product of the 24 hour incubation time needed for water sample analysis. Coles Creek Beach was selected as the primary test location for the study. Hydrodynamic modeling was used to select several upstream sample locations of interest. Field personnel collected water quality data such as turbidity, CDOM, Conductivity, temperature, and E. coli CFU/ml. Meteorological data was compiled from various sources. A subset of these variables was used to create a MLR model for E. coli at Coles Creek Beach. This model is still in the process of refinement. Data quality of dilution assay data was sought to be improved through the use of outlier detection algorithms. Dilution assays were performed to determine growth and grazing rates of plankton in the St. Lawrence River. Dilution assays are inherently difficult and expensive to run and erroneous data can affect results. Through the application of outlier detection techniques erroneous values were sought to be eliminated from data sets to yield cleaner results which saves time and the expense of performing additional experiments.

Modeling Two-Phase Flows with Surface Tension using the Ghost Fluid Method

Kyle Perline
MAE Department

Two-phase flows, characterized by the interaction of either two immiscible liquids or a liquid and gas, are ubiquitous in engineering and scientific research projects. Examples of two-phase flows include oil slicks on the water's surface, the formation and implosion of bubbles on an underwater propeller, and the dispersion of liquid fuel droplets into the combustion chamber of engines. In all of these examples the exact small-scale behavior of the system is dependent upon surface tension acting on the interface of the two fluids. It can be difficult to account for surface tension forces when modeling fluid flows, and so this thesis develops a new and simple technique to handle surface tension by using the Ghost Fluid Method framework. Across the interface in two-phase flows there are often discontinuities in the pressure, density, and velocity, and the Ghost Fluid Method requires the use these jumps. Most methods attempt to handle surface tension by treating it as a force acting at the interface, which is difficult to do; however, since surface tension can also be treated as a pressure jump between two fluids, the Ghost Fluid Method will easily account for the surface tension by only considering the pressure jump it creates. This new technique will be much more straight-forward and natural within the Ghost Fluid Method framework than other existing methods.

Design, Fabrication and Implementation of an Actuator and Cable-Driven Mechanical Whirligig Beetle

Jill Clevenger

Mechanical and Aeronautical Engineering

The goal of this work is to develop a planar robotic mechanism that can simulate the motions and actions of a Whirligig Beetle on the surface of otherwise still water. This device will enable the stimulation of groups of beetles in repeating patterns for purposes of studying the behaviors and movement of animals in groups. The objective is the precision control of a decoy beetle at speeds of up to 0.5 m/s over a closed surface area of water (0.3 m²). To achieve the requisite performance, a three degree-of-actuation (DOA), two degree-of-freedom (DOF) cable-driven manipulator has been designed. This talk will present a detailed description of the cable-driven robot, including the integrated sensors for measuring cable excursion and tension in each actuator, and preliminary control architecture for precision position control of the end-effector over its range of motion. The controller leverages the unique mapping between tension distribution and end-effector position to achieve position control using continuous variation in cable tensions about a nominal pretension set point.

Corrosion Characteristics of Nano-Grained and Coarse Grained Copper in H_2SO_4 and NaCl Solutions

Yassine Khitass
Josh Gale & Dr. Ajit Achuthan
Institute for a Sustainable Environment

Copper is an excellent conductor of energy and is widely used in many electrical applications. Its mechanical response in corrosive environments makes it an ideal candidate for the anode in an electrochemical Cell. Copper containing nano-sized grains have also been shown to enhance resistance of the copper surface to corrosion. In this study, nano-grained and annealed coarse grained copper samples were immersed in an electrochemical cell (Potentiostat) to investigate the difference between their corrosive potentials in both H_2SO_4 and NaCl salt solutions. . In most electrochemical corrosion experiments, the first step is the measurement of the Open Circuit Potential (OCP) and Corrosion Potential (E_{cor}), and these are usually interchangeable. A potentiostat allows us to change the potential of the copper sample in controlled manner and measure the current that as a function of the potential. A tafel was used to study and compare the corrosion current (which is the measure of Corrosion Rate). According to the tafel plot produced we can deduce small differences between nano-grain and annealed copper samples. We did not observe any difference between Sodium Chloride (NaCl) and Sulfuric Acid (H_2SO_4) salt. There appears to be no effect from the substitution of NaCl in either copper sample. In H_2SO_4 the current and potential corrosion drop, but are not efficient. Further research will be conducted using a corrosion inhibitor to attempt to increase the efficiency of the corrosion potential.

Compression of Natural Gas as Use of Wind Turbine Energy

Ian Smith

Mechanical and Aeronautical Engineering

Could the compression of Natural Gas be used as a viable way to use wind power on the Clarkson Campus? The research will determine the viability of this system from both a position of efficiency as well as a position of finance. The research will find the amount of need on campus and from there find the most efficient compression system and wind turbine to serve the project. Finding the viability of a compressed natural gas system could potentially have a large impact on the Clarkson maintenance fleet, which could convert to Compressed Natural Gas, reducing Clarkson's carbon foot print immensely. To gather data, research on the internet for up to date information will provide a base to work from, while prices of vehicles, costs for conversions, the compression system and the turbine will determine the financial viability. For the efficiency standpoint, working with and creating MATLAB codes will help determine the right equipment for the need on campus as well as allow for easy adjustments to the scenario. Collected data shows the amount of need on Clarkson Campus will be more efficient with a small system. Collected data also shows the payback period could be offset by the introduction of public sales or to companies that use fleet vehicles looking for cheaper fuel costs. When coupled the results of the research show that a Compressed Natural Gas system could be a viable use for energy from a wind turbine and to power vehicles on campus.

Characterization of Fatigue Induced Fractures in Aluminum Foam Using X-Ray Computed Tomography

Orion L. Kafka

Mechanical and Aeronautical Engineering

Low cycle fatigue cracks in Alporas closed cell aluminum foam are examined. Alporas foam has desirable mechanical properties including: good vibration damping, high strength and stiffness to weight ratios, and high thermal conductivity. X-ray computed tomography was used with accompanying reconstruction and viewing software to produce three-dimensional images. These structures were examined to characterize the mode of fracture propagation in Alporas foam having undergone fully reversed (tension-compression) uniaxial fatigue loading at nominal strain rates between 0.05% and 0.5% in a previous study. The myVGL 2.1 and VGStudio MAX 2.1 software packages were utilized in systematically searching for fractures within each specimen. Markers were placed along the fracture edges, as seen in Figure 1; the coordinates of each marker were then imported to MATLAB to allow for location and orientation analysis of the cracks. Initial findings indicated that cracks occur primarily in a planar zone and appear rather jaggedly edged and tortuous; they tended to propagate through cell walls, yet cracking through relatively thick junctions was noted. However, fractures seem to have followed a general directional trend. In the previous study, the Alporas specimens were fatigued under digital image correlation surveillance to determine sectors of high extensile strain. The surfaces were inspected to find associated visible fractures. The previous work hypothesized that cracking occurred in zones of high strain in the material. Results from the current work suggested that the zone model was corroborated; however, examination of more specimens is required to fully characterize fracture in fatigued Alporas foam.

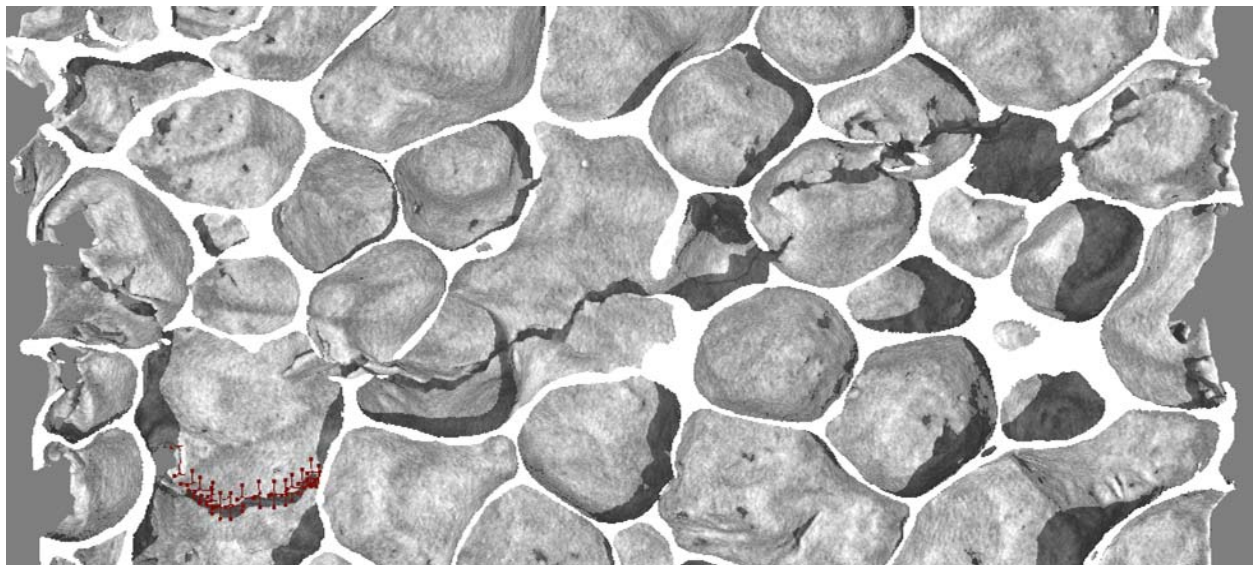


Figure 1: A partially marked crack in the foam, as seen in myVGL 2.1.

Characterization of Rad51 Phosphorylation in Cardiomyocytes

Caitlin Mincer

Dr. Zhiyong Mao Ph.D & Dr. Vera Gorbunova Ph.D
Biology Department, University of Rochester

DNA Double-strand break (DSB) is the most detrimental type of DNA damages caused by external ionizing radiation, chemical or internal collapsed DNA replication forks, and reactive oxidative species. If unrepaired or repaired improperly, it results in an increased susceptibility to genome changes due to deletions and mutations, which ultimately contributes to apoptosis, senescence, or the formation of cancer cells. The homologous recombination (HR) pathway is one mechanism of repair employed by the cell. The HR pathway has been identified as a more precise method of DSB repair in contrast with non-homologous end joining (NHEJ). Homologous recombination utilizes a template DNA strand from the sister chromatid to reconstruct the damaged DNA strand; this pathway is considered an error-free method of DNA repair. HR utilizes the genetic recombination enzyme, Rad51 within the DSB repair pathway, which functions mainly in the presence of sister chromatids by facilitating the formation of Rad51 coated DNA for invading into homologous region on sister chromatids. In this study we show that Rad51 is surprisingly expressed in post-mitotic cells, specifically cardiomyocytes, through Western Blot analysis while in fast growing cardiofibroblasts there is no Rad51 expressed. We also demonstrated the Rad51 present in myocytes is phosphorylated at the tyrosine Y315 end. The function of Rad51 in these cells are being further determined.

Comparison of Plankton Dynamics in Nearshore and Main Channel Areas of the St. Lawrence River

Nicole Kinlock*

Sarah Loftus, Nick Marshall, Dr. Joseph Skufca & Dr. Michael Twiss
Biology

The St. Lawrence River (SLR) is not a homogeneous stream of flowing water, but can be separated instead into two distinct regions, nearshore and offshore, each with discrete water characteristics. Nearshore water flows at a low velocity and can be affected by tributary mixing while main channel water is distinguished by high velocity. These divergent environments can support different communities of phytoplankton and microzooplankton that can be assessed by calculating their state (biomass) and rate (growth and loss due to grazing) variables. By characterizing the plankton dynamics and water qualities of these two regions, it can be determined to what extent main channel (offshore) river water is different from nearshore water. A series of phytoplankton state and rate variables were calculated from 55 dilution assays with water samples collected from nearshore and main channel regions along a 30 km stretch of the International Section of the SLR between May and June 2011. Both state variables such as phytoplankton biomass, dissolved nutrients, and chromophoric dissolved organic matter (CDOM) and rate variables such as chlorophyll-a-specific growth and grazing rates were found to be significantly different ($P < 0.05$) between main channel and nearshore regions of the river. This difference can be attributed to the low velocity of nearshore regions and influence of tributary mixing. These data support the notion that this major river is a dynamic system with an array of water qualities constituting distinct regions.

Delineating Zones of the St. Lawrence River in Support of a Two-Dimensional Ecosystem Model

Sarah Loftus

Nicole Kinlock, Nick Marshall & Dr. Michael Twiss
Great Rivers Center at Clarkson University

Geomorphology and tributary inputs define the flow and mixing patterns of a river system, which in turn establish various regions of distinct water characteristics within a river. The International Section of the St. Lawrence River (ISSLR) exhibits such regions due to partial mixing from small tributary inputs, tortuous routes through archipelagoes and shoals, and water level management imposed by the Moses-Saunders Power Dam in Massena, NY/Cornwall, ON. The regions differ in their capacities to support organisms such as phytoplankton, and can be mathematically modeled by merging velocity vector data and water quality data. Water characteristics including temperature, specific conductivity, and chromophoric dissolved organic matter (CDOM) were continuously measured by instruments onboard a research vessel while covering transects across the width of Lake St. Lawrence, a fluvial lake caused by impoundment from the dam. Total phytoplankton biomass was also determined at certain locations by sampling water and extracting chlorophyll-a to measure fluorometrically. Zones of the river can be delineated by mapping and interpolating water characteristics. Zones will be incorporated into a hydrodynamic model to predict plankton dynamics in the ISSLR, measured in a related project. Having a means to predict the rates of change of these microorganisms is critical because of the regulated nature of the ISSLR and the importance of plankton on aquatic ecosystem dynamics.

Species Composition and Abundance of Turtles at Restored versus Natural Wetlands in the St. Lawrence River Valley of New York State

Nychele Carley
Dr. Tom Langen
Biology

Over the last several decades, wetlands have declined precipitously in North America due to drainage and land conversion to agriculture and other land uses. Programs such as the USDA National Resource Conservation Service's Wetland Reserve Program (WRP) and the US Fish & Wildlife Service's Partners for Fish and Wildlife Program (PFWP) restore wetlands with the goal of reestablishing ecosystem services and habitat for wildlife. Little is known about whether WRP or PFWP restorations are similar to natural wetlands in terms of functioning and biodiversity. The objective of this study was to test this by sampling turtle diversity at 31 restorations and 16 natural wetlands in the St. Lawrence Valley of New York, to compare relative abundance and diversity of turtles. Hoop trapping was performed for 30 trap/nights at each site in the month of June. We detected painted turtle, snapping turtle, and Blanding's turtles at both restorations and natural locations. We found that wetland type is a significant predictor for both trap success and the abundance of snapping turtles. The proportion of male snapping turtles was higher in natural wetlands, while the proportion of female snapping turtles was higher in restorations. Turtles were similar in age at both wetland types. Therefore, we conclude that turtle community structure is similar in restored and natural wetlands, and that turtles may be a good indicator for well-functioning restorations.

Are Submerged Aquatic Vegetation a Sink for Phytoplankton in the St. Lawrence River?

Eric Slaugh
Dr. Michael R. Twiss
Biology

The hypothesis tested was that the decrease of phytoplankton populations in the International Section of the St. Lawrence River as it flows downstream from Lake Ontario is caused in part by submerged aquatic vegetation (SAV) found on the bottom of the river. In order to test this theory, Goose Neck Island Shoal (GNIS), a 231 hectare shoal located in the middle of the river, was chosen to explore the effects of SAV on the phytoplankton population. This study was similar to experiments conducted in 2009 and 2010. To better visualize the effect that the shoal has on phytoplankton populations, the basic limnological properties of the shoal, such as area, flow rate, volume of water above shoal, and mean depth were calculated. *Elodea Canadensis* was chosen to represent SAV and procured through snorkeling. The retrieved vegetation was used to set up a series of assays designed to assess the impact of epiphytic zooplankton on the surface of SAV on phytoplankton. The tests are designed to assess the impacts that large amounts of SAV, such as that found on GNIS, have on the phytoplankton population and/or the size fraction of microplankton (>153-20 μm), nanoplankton (20-2 μm), and picoplankton (2-0.2 μm) in the water. This information can be used to account for losses of phytoplankton from the water column and how this may be affected by changes in water levels in the river with changing environmental conditions.

A Self-Consistent Field Model for Electrolytic Polymers to be used for Photovoltaic Applications

Veronica Corneau
Dr. John McLaughlin
Chemical and Biomolecular Engineering

The objective of the research project was to create a more realistic model for non-Gaussian polymer chains. A self-consistent field model was solved using a MATLAB program to obtain the volume fractions of the mers as a function of position. The model originally assumed a cubic lattice formulation and that the polymer chains were fully flexible, (Gaussian). The latter assumption has two unphysical implications: (1) real polymer chains have bond angle restrictions that preclude a completely random walk, and (2) according to the Gaussian model, chains can intersect themselves (two mers can occupy the same lattice site). According to the Gaussian model, a chain could move in the forward direction, backward direction, or four possible perpendicular directions with equal probabilities. An existing MATLAB code was modified to include a bending energy, ϵ , and back-folding was eliminated from the code. The project created a more realistic model which better predicts the behavior of polymers. The model will be used for photovoltaic applications such as predicting the way Ionic Liquids in Dye-Sensitized Solar Cells (DSSC's) behave. Ionic liquids are being researched in hopes of developing a cheaper solution to the production of solar cells as an alternative to the current material which is silicon. The formulation of a more environmentally friendly, and energy efficient power source is necessary for the future.

Portable Impedance Sensors for Detecting Endocrine Disrupting Chemicals (EDCs)

Maggie Leung

Dr. Ian Suni

Chemical Engineering

Endocrine disrupting chemicals (EDCs), such as norfluoxetine, affect the endocrine system, so environmental exposure can lead to health problems. An impedance biosensor containing an antibody-coated electrode can be used to detect EDCs. A Nyquist plot illustrates the impedance response to EDC binding as a function of frequency, and can be modeled using simple equivalent circuits. Typically, the charge-transfer resistance is the equivalent circuit element most sensitive to EDC binding. Since norfluoxetine is much smaller than a protein antigen, detection is more challenging. Therefore, norfluoxetine conjugation to horseradish peroxidase (HRP) is useful to amplify the impedance signal change.

Modeling Energy Efficient Distillation Columns while Accounting for Mass Transfer Influences

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. Due to the large volumes of liquids which must be vaporized to exploit differences in boiling points, distillation columns account for approximately seven percent of the total energy consumed in the US. Additionally, there are large overhead costs associated with building and testing these columns. Thus, initial design is 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 column design. Further, our goal is to examine columns which act as a chemical reactor and separation unit, saving both construction and energy costs. Modeling these two complex phenomena together is challenging, however there is great potential for improving distillation column design as a result.

Effectiveness of Mathematical Models for Surface Tension Calculations in Distillation Processes

Kyle Hancock
Chemical Engineering

Mathematical modeling provides a multitude of methods to determine properties of chemical reactions under various stresses. It is particularly valuable under conditions that are not easily simulated in a laboratory. However, in areas where modeling data will be implemented, it is especially vital for an individual to recognize all possible shortcomings of a particular method, thus ensuring that error margins can be accounted for. Recognizing such limitations for various surface tension calculation methods is the object of the following study. Models tested were common methods utilized to model chemical processes like distillation and absorption. Chemical systems were analyzed using a variety of functions in the ChemSep™ modeling software, with results being compared to data from literature. From such results, an ideal “fitted” solution was created; analysis of correlations between different stresses and trends was performed. Results indicated that current modeling methods are only effective with simple systems and relatively standard conditions. Further research must be performed in the development of improved surface tension calculation methods.

Drug Release Kinetics from Polyanhydrides

Nicole Traphagen
Chemistry and Biomolecular Sciences

Most polymer based drug delivery systems contain polymers that degrade by bulk erosion. The release of materials from these bulk eroding polymers cannot be easily modeled using zero, first or second rate laws. Using surface eroding polymers instead can solve many of the problems associated with bulk eroding polymers as drug delivery systems, including the initial concentration spike followed by a rapid decline of the amount of drug released. Polyanhydrides have been extensively researched for drug delivery because they are surface eroding and usually biocompatible. In our work, polyanhydrides were created using the monomers 4-pentanoic anhydride and pentaerythritol tetrakis (3-mercaptopropionate) using photoinitiated thiol-ene polymerization to create a cross-linked polymer. Bupivacaine and Acid Orange 8 dye were used as models to study drug release from these polyanhydrides. The polymers were degraded in phosphate buffered saline solution at a pH of 7.4 and kept in motion in order to mimic conditions in the human body. In addition, some polymers were degraded in a water bath kept at 37 °C to model human body temperature. The amount of the drug mimic released was determined using UV-visible spectroscopy. Initial results suggest that the release follows a zero order rate law beginning approximately 3 to 10 hours into the degradation. This release rate does not appear to have an exact correlation with mass lost by the polymer, which did not begin losing mass until about a day into the degradations.

Synthesis of Vinyl Acetate – Polystyrene Block Copolymers by Using a Single Reversible Addition Fragmentation Chain Transfer Polymerization Agent

Lily Dayter

Chemistry and Biomolecular Sciences

Reversible addition-fragmentation chain transfer (RAFT) polymerization using dithiocarbamate-based compounds as “RAFT agents” have been shown to assert control over radical polymerizations, producing a wide range of polymers with predictable molecular weights and narrow weight distributions. However, specific RAFT agents often are unable to control molecular weight growth of polymers made up of monomers with disparate reactivities. Two such monomers are vinyl acetate (VAc) and styrene (S), with the former polymerizing very fast because of the destabilized radical intermediate when compared to the latter monomer. However, the RAFT agent malonate *N,N*-diphenyldithiocarbamate (MDP-DTC) has been previously used to polymerize both VAc and styrene with reasonable control. PVAc has a plethora of applications but, in the past has been particularly hard to control. PVAc has been used in a variety of adhesives and plastics, as well as water based paints. More notably, PVAc can be used to produce other polymers like poly (vinyl alcohol) and poly (vinyl acetal), that are unable to be polymerized directly. By combining styrene into PVAc, and especially as a block copolymer motif, many new properties and film nanostructures may be obtained. Therefore, the synthesis of block copolymers containing polystyrene and VAc has been attempted to display the versatility of the RAFT agent. All monomers were purified through fractional distillations and pre-synthesized MDP-DTC RAFT agent was used in the polymerizations. The reactions were analyzed using gel permeation chromatograph (GPC) and ^1H nuclear magnetic resonance (NMR) spectroscopy techniques to determine the molecular weight, polydispersity and the percent conversion, respectively. This is the first time that VAc and styrene have been successfully polymerized into a block copolymer using a single RAFT agent to control the growth of both monomers.

The Synthesis of Polyimides Through Thiol-Ene Polymerizations

Brianne Kiliman

Chemistry and Biomolecular Science

Thiol-ene polymerization is a unique type of chemistry that forms structurally homogeneous networks through a radical-mediated step-growth polymerization process. Thiol-ene polymerizations have been found to give networks with unique properties such as uniform mechanical and thermal properties, high reaction yields, mild reaction conditions, and are insensitivity to oxygen or water. They are also very versatile because of the wide variety of readily available starting compounds. While thiol-ene polymerizations are useful there are still some features that still need improvement. For example, the glass transition temperature (T_g) of thiol-ene polymers, which is a measure of the softening point of the material (i.e. when it transitions from a glass to a rubber), is often low. Thiol-ene polymers have glass transition temperatures that are normally lower than 20°-30°C. This causes the resulting materials to be very elastic and soft at room temperature. This is not ideal for many applications. In our work we have added an aromatic imide functional group into a vinyl-capped monomer, with the expectation that it will add structural rigidity to the polymer, thus increasing the T_g . It is anticipated that this will improve the thermal, physical and material properties of the resulting thiol-ene polymer.

Release of Drug Models from Surface-Eroding Polyhydrides

Khrystyna Dilai

Chemistry and Biomolecular Science

The need for safe, biodegradable polymers capable of releasing drugs into the human body is growing. Surface-eroding polymers, such as polyhydrides, have significant potential in this area because they keep their shape as the polymers degrade and release the contents into the environment around them. Unlike bulk-eroding polymers, which degrade throughout the structure, polyhydrides have the capability of releasing drugs at a constant rate (i.e. zero-order release kinetics). The goal of the project is to determine if a polyhydride loaded with the hydrophobic non-steroidal anti-inflammatory drug (NSAID), bupivacaine shows zero-order release kinetics. Knowing the release rate of the bupivacaine would aid in predicting the release rate as well as behavior of other NSAID drugs that could be loaded in the polymer in the future. In our work, the bupivacaine-polymer mixture was cured and then degraded in a phosphate buffered saline solution at a constant pH of 7.4 and room temperature, with samples taken every few hours to measure the concentration of bupivacaine in the solution using UV/visible spectroscopy. Because of this, it was also necessary to determine the extinction coefficient at 271nm using Beer's Law. The order of the release rate determined using the cumulative concentration of the bupivacaine was found to be more complex than simple first-order.

Cement Free Low-Embodied-Energy Concrete

Lenard Tran

Dr. Sulapha Peethamparan

Civil and Environmental Engineering

The search for new binding materials to replace traditional Portland cement has been an ongoing process in the field of civil engineering. A new sustainable, low energy cement free concrete is developed by activating ground granulated blast furnace slag and fly-ash using commercial alkalis. Mortar specimens were prepared using two different activators namely, sodium silicate and sodium hydroxide at different concentrations. The compressive strength of activated slag mortar was measured at 1, 7, 14 and 28 days. The compressive strength of fly ash mortar was measured after 24 hours and 48 hours of elevated temperature curing in a conventional heating oven. The results show that slag mortar developed maximum compressive strength at 5M NaOH concentration as compared to 8M and 12M. The results also show that nano Silica, an additive material which was added to the fly-ash batch, helped increase the compressive strength of class C fly-ash. However the compressive strength of class F fly ash yield much higher value than class C fly-ash as well fly-ash with nano silica.

Effect of Internal Curing on Compressive Strength and Shrinkage of Alkali Activated Cement Free Concrete

Margueritte N. Ngami

Dr. Sulapha Peethampanan

Civil and Environmental Engineering

Alkali-activated concrete or cement free concrete is a new type of concrete developed without the use of Portland cement. Several sets of alkali-activated concrete were developed in the laboratory by using class C fly ash and class F fly ash as the starting materials and sodium hydroxide and sodium silicate as the alkali activators. In alkali-activated concrete, shrinkage is reported to be a significant problem. In this research, the role of internal curing in alkali-activated concrete to enhance the engineering properties such strength and shrinkage is determined. For internal curing, 30% of the normal weight aggregate is replaced with saturated surface dry lightweight aggregates. The compressive strength of the concrete incorporating lightweight aggregates is determined and compared with alkali-activated concrete using normal weight aggregates. The data showed that internal curing improves the compressive strength of cement-free concrete at a lower water/cement ratio.

Early Age Properties of Alkali Activated Binding Materials

Ji Zhang

Civil and Environmental Engineering

Several batches of alkali activated cement free concrete were developed using slag and fly ash as the starting materials and sodium hydroxide and sodium silicate as the activators. Cement free concrete/alkali activated concrete is a more environmental friendly concrete than the normal Portland cement concrete. This type of concrete uses industrial by products as binding material instead of Portland cement and hence reduces the CO₂ emission significantly. The early age behavior of the alkali activated concrete developed in this project is evaluated by determining the workability (mini slump test), chemical shrinkage, initial and final setting times (Vicat Needle penetration) tests. The role of the type of starting materials, type and dosage of the activators on the early age properties of alkali activated concrete is determined. The results showed that sodium silicate (1.5 mod) activated class C fly ash has the shortest setting time. Whereas, Sodium Hydroxide (5M) activated class class F fly ash has the highest workability. In summary, it was found that the early age properties of alkali activated concrete may be an issue with respect to the practical application of this concrete in the field.

Engineering Properties of Clays Stabilized With Class C Fly Ash

Brooke Clare¹

Dr. Sulapha Peethampan²

Civil Engineering

Conventional soil stabilizers such as lime and cement are added to the soil to modify or stabilize the engineering properties of clays and soils. Both additives change the texture and moisture content of the soils. Therefore, improving the workability, increasing the shear strength, reducing the plasticity and reduce the volume change potential. However, the production of lime and cement involve energy intensive process and their production causes CO₂ emission. By replacing these additives with an industrial by- product such as Class C Fly ash, clay properties can be greatly enhanced. Class C Fly ash is a waste material produced from the combustion of coal in thermal power plants. In this research Class C FLY ash was used as a potential stabilizing agent for Kaolinite and Na-montmorillonite clays. The engineering properties such as the plasticity index and unconfined compressive strength will be determined in comparison with neat clays. The cause of the enhanced performance will be explained using microstructural and mineralogical examinations of the stabilized systems

Electric Vehicle Infrastructure Systems

Bryan Davidson, Sky McDonough, Nick McNulty & Jessica Stanulevich
Electrical & Computer Engineering
Mechanical & Aeronautical Engineering

Clarkson University partnered with AeroVironment to conduct a feasibility scoping study regarding an electric vehicle (EV) infrastructure system designed for the university. An EV infrastructure would enhance the university's dedication to innovation and sustainability. The study aims to involve Clarkson vehicles, students, faculty, and community members. Integration into Clarkson's campus would occur in stages, the first being the transition of maintenance and grounds vehicles to EVs through staggering them throughout the regular vehicle replacement schedule. Level two chargers would then be placed throughout campus for student, faculty, and community use. Electric vehicles for commuting purposes could be provided for rentals to complete the shift to sustainable transportation. In order to ensure environmental benefits, and a system with zero emissions, a microgrid would be required. This involves installation of renewable technologies such as wind turbines and solar panels. Present internal combustion engine vehicles were tracked with GPS software to collect driving habit data. Analysis of GPS data confirmed the potential opportunity for EV integration. Campus vehicles perform within the limited range of an average EV and many professors reside within a distance that makes EVs a logical solution. In regards to required charging infrastructure, the Queueing Theory is being used to provide statistical models of the density of and the wait time at fast charging stations. This model will assist with proposed quantity and placement of EV chargers. Overall, EV infrastructure has high initial cost, but this zero emissions solution is a feasible option for Clarkson University.

Electric Vehicle Infrastructure Systems

Bryan Davidson

Electrical & Computer Engineering

Interest in the electric vehicle (EV) market can be seen as beneficial to the environment, but also comes with drawbacks. The main concern behind the EV movement is the infrastructure required to support such a shift in driving habits. The implementation of an EV infrastructure comes with potential dilemmas that must be considered, including the limited range of EVs and the need for available charging stations. An immediate objective of this research is to analyze the potential for car dealerships to install level three fast charging stations available to the public. The initial calculations performed using car dealerships in St. Lawrence County determine that EVs are much more energy efficient in terms of travel distance due to the use of motors rather than combustion engines. After mapping the set of dealerships, the results concluded that car dealership density is directly proportional to population density. It is now required that comparisons be made to currently planned EV infrastructure on the west coast of the United States. From this information, feasibility of EVs in St. Lawrence County can be measured. The Queueing Theory, a theory of computer networking will be done to provide statistical models of the density of and the wait time at fast charging stations. This model will assist with proposed quantity and placement of EV chargers. The proper planning of EV infrastructure combined with the acceptance of EVs by society could lead to greater participation in the revolution towards zero emission transportation.

Thermal Effects on Characteristics of Single Junction Silicon Photovoltaic Cells

Charles McGuffey

Electrical and Computer Engineering

Temperature has profound influences on the performance of photovoltaic cells. The objective of this research is to study the characteristics of a silicon solar cell influenced by cell temperature. Studying the data that reveals the temperature effect on photovoltaic cells allows scientists and engineers to estimate solar cell characteristics under certain conditions, permitting the creation of optimal solar cells/arrays under certain conditions. As the efficiency of solar cells increase, solar power becomes a more economically viable option. This increased viability allows the replacement of non-renewable, polluting power sources like coal with clean, inexhaustible solar power. The research uses the PC1D software package to simulate photovoltaic cells with the desired parameters and generate necessary data. This data includes the Current versus Voltage curves, the Short Circuit Current I_{sc} , the Open Circuit Voltage V_{oc} , and the Maximum Power at various sun irradiances and temperatures. The data is then used to calculate the Fill Factor, Quantum Efficiency, and Power Efficiency of the photovoltaic cell, and determine the sensitivities of these quantities to temperature. Results indicate that in silicon solar cells I_{sc} increases slightly with temperature and V_{oc} decreases more evidently as temperature is raised. Consequently, the solar cell loses its efficiency as the cell is heated up by sun irradiance. It is also found that the efficiency is enhanced if the solar cell is exposed to stronger sun intensity. The study provides useful information on how material bandgaps and cell temperature affect the photovoltaic operation.

The Functionality of Electric Vehicles on the Clarkson Campus

Nicholas McNulty

Dr. William Jemison & Dr. Kenneth Visser

Electrical & Computer Engineering

Mechanical & Aeronautical Engineering

The United States spends over \$700 billion on crude oil imports per year. About two thirds of the oil imported is used in gasoline, projecting annual spending around \$467 billion on gasoline alone. This project reviews the possibility of Clarkson University to create, maintain, and sustain a campus which can support Electric Vehicle (EV) usage. The main problems facing an electric vehicle structured campus include the availability of charging stations, the distance at which an EV can travel before needing to be charged, and the purpose for which the vehicles will be used. To manage availability, several factors are taken into account. Primarily, there are three types of charging stations. Based on a battery's charge capacity, level one chargers take 8-24 hours to charge, level two chargers take 4-8 hours, and AeroVironment's "fast charge" takes 10-30 minutes. Using the fast charge times and the Queueing Theory, it is then possible to estimate the time it takes an EV to charge dependent on when it arrives at a charging unit and how many cars have arrived before it. To account for the distance an EV can travel, several possible EVs have been examined based on their usage and capabilities. Based on Clarkson's desire to replace service utility vehicles, Nissan's *Leaf*, Ford's *Transit Connect Electric*, and E-Ride's *EXV2* or *EXV4* are being researched as plausible replacements. Using economic factors, mathematical probabilities, and AeroVironment's innovative charging station, the plausibility of Clarkson University to have a functional EV campus will be examined.

An Introduction to the Benefits of Variable Pricing of Electricity

Chase Turose
Electrical Engineering

Wholesale electricity prices fluctuate based on demand, but retail power utilities rarely vary electricity prices to match these fluctuations. Instead, they charge a flat rate based on what those prices will likely be. Because retailers cannot know exactly how the prices will fluctuate, they assume all of the risk, forcing them to charge high flat rate prices to compensate. With flat rate pricing, consumers have no incentives to adjust their energy consumption, causing them to use more electricity than necessary at peak hours, driving wholesale electricity prices up. Demand responsive dynamic pricing provides incentives for consumers to change their consumption patterns during those peak hours. This research uses air conditioning as an example to demonstrate the benefits of implementing such a system. Specifically looking at New York State, this research demonstrates the savings from switching to dynamic pricing, as well as the savings from changing air conditioner usage patterns based on the dynamic prices and the outside temperature. Using an equation from a similar study in California to calculate the energy usage of air conditioners, this research illustrates that substantial reductions in both cost and energy usage are possible. Finally, this research explores how consumers could program their air conditioners based on day-ahead temperature predictions, with a 1/3 probability of slightly higher than predicted temperatures, a 1/3 probability of predicted temperatures, and a 1/3 probability of slightly lower than predicted temperatures. Using such techniques, consumers could save without having to implement expensive real-time price and weather monitoring systems.

Use of Notch Signaling Pathways in the Decision between Secretory and Absorptive Cell Fate in the Digestive System of Zebrafish

Aisha Wood
Dr. Kenneth Wallace
Biology Department

Using the zebrafish as a model system we intend to determine what genes and ligands involved in Notch signaling are responsible for the absorptive or secretory fate of enteric neurons of the intestine. The *her* gene, which has many variations, assists in turning on absorptive fate and is of particular interest in this project. The *her* gene and its effect is studied by exposing embryos to DAPT and terminating Notch signaling. We also use RNA *in situ* hybridization to stain the embryos at different time points and determine where the *her* gene expression is located in the intestine.

Role of Notch Receptors and Ligands in the Differentiation of Secretory and Absorptive Cells

Patricia Beutel
Dr. Kenneth Wallace
Biology

The model organism, zebrafish was used to define development of serotonin secretory cells pertinent to human Irritable Bowel Syndrome. The time and place of genes involved in secretory cell development were observed using RNA *in situ* hybridization. In order to determine the role of these genes in differentiation of secretory cells, a morpholino or morphant was used. The development of the morphant was then monitored in order to identify what affect the absence of that specific gene had on secretory cell development and motility.

Identification of Genetic Patterns Related to Placentation in Mammals and Reptiles

Augusta Collier
Dr. James Schulte
Biology

Modern reptiles and mammals are derived amniotes meaning they share a common pattern of development including an amniotic sac, chorionic and allantoic membranes that protect and feed the young. All placental mammals have live birth but at least 20% of all reptiles, specifically lizards and snakes have live birth as well; some with placentas as complex as mammalian placentas. There are numerous well-known internal, physiological processes functioning to support the developing embryo including transport of nutrients and oxygen, waste removal, protection from microbes, temperature regulation, and hormone production. However, there remains little data on the genetic and cellular processes functioning in the placenta of mammals but especially reptiles with live birth. Several recent advances in computational biology and genomic sequencing techniques have greatly improved our ability to identify the genes, their expression levels, and function in whole tissues (transcriptomes) at different developmental time stages. The purpose of my research is to use several genomic databases to identify gene expression levels in the placenta of humans and mice. The data on these genes and associated genetic processes were compared with recently acquired data from the oviduct during two developmental stages in the viviparous Australian scincid lizard *Pseudomoia pagenstecheri*. The genetic functions and processes expressed in the mammalian and reptilian tissues were compared with numerous similarities found between all these tissues. These similarities will be presented as well as several of the major differences between humans and mice and mammals and the two reptilian tissues.

Applications of Image Decomposition in the Description of New Species

Adam Hellmann & Annie Murphy
Biology & Mathematics

When new species are described, much attention is given to the analysis and description of their morphological, or physical, characteristics. These differences may be too subtle to easily be distinguished visually, as in the case of *Calotes versicolor*, a lizard found throughout Southeast Asia. DNA sequencing evidence suggests that the *versicolor* species may be comprised of multiple distinct species, however this evidence is not conclusive. We used image decomposition and the analysis of the separated texture to extract and analyze data about the lizards' scale structure. This information, coupled with a statistical analysis of our own morphological data was used to determine whether the findings substantiated the claim of the existence of multiple *versicolor* species presented by the DNA evidence.

Introduction to Proteomics and its use to Identify Serum Biomarkers

Andrew Wegner
Dr. Costel C. Darie
Biochemistry

Research scientists and medical doctors have been looking for detection methods to diagnose early stages of diseases such as cancer. Through the use of proteomic experiments, earlier detection of potential serum biomarkers is possible by identification and validation of common serum biomarker candidates, in individuals afflicted by the same diseases, compared with the healthy controls. In the experimental phase Tricine-PAGE gel electrophoresis was used to separate the serum samples from patients with various types of cancer and from normal subjects. The experiment was an unbiased, blind experiment: the researcher had no information about the type and source of the sera that were analyzed. Once Tricine-PAGE was completed, the gel was stained by Coomassie Brilliant Blue, scanned, and analyzed for differentially stained patterns. The gel bands of interest were excised, digested by trypsin, and analyzed by liquid-chromatography-mass spectrometry. The raw data files were processed with Protein Lynx Global Server and then submitted to Mascot database search for protein identification. The Mascot results were validated by identification in the raw data files of the mass spectra that corresponded to the peptides identified in Mascot search. These experiments were further validated using Western blotting experiments. The broader impact of this research is to identify serum biomarker candidates that may be used in clinical settings to identify early stages of cancer.

Fishing for Answers: The Synthesis and Study of Jagged3 Clones in a Zebrafish Model

Emily Dreisbach
Biology

The development of embryos has been a long-studied subject, although recently the interaction and development of the intestinal system has been closely researched. The intestinal system is populated by many neurons, which are inextricably linked with the development of smooth muscle which is responsible for the propulsion through the intestines. Using Zebrafish as a model having correlations to human development, embryos were examined to study the differentiation and migration of neurons in the intestine. Jagged1B, Jagged2 and Jagged3 clones were the focus of this study. These clones are responsible for signaling neurons in the digestive tract. A RNA *in-situ* hybridization was run on Jagged1B and Jagged2 synthesized probes, but neither presented a staining pattern. Both clones were sent off for sequencing as a fault may have occurred in the plasmid in which the clones were inserted. Jagged3 was transformed from supercoiled DNA into an LB culture. This LB culture was then processed with a Qiagen Midiprep kit to purify and elute the DNA. The DNA was then inserted into an Agarose gel for electrophoresis; only Jagged3 presented faint banding. RNA *in-situ* hybridization was performed on J1B, J2 and Her6 as a standard to which staining patterns were compared. Staining did not occur, with only NBT precipitating in large quantities. With inconsistent results and staining, it was concluded that human error was the main source. While the results did not yield the desired outcome, the clones have the potential to aid in the study of neuron migration.

Nano-Physiology of Drosophila Heart

Katherine Price

Maxim Dokukin, Nataliia Guz & Dr. Igor Sokolov

Physics

Heart problems are the number one cause of death among humans worldwide. Early diagnosis of heart defects in human patients is still a challenge today. The acoustic methods are some of the oldest techniques used for the detection of heart defects. Our group has recently developed a novel method that detects surface vibrations millions of times smaller than the most sensitive microphones. Thus, it may result in a serious advance in the early diagnosis of heart problems. The technique is based on the atomic force microscopy (AFM) platform. A very fine AFM probe touches the surface of interest, and the oscillation of the probe is recorded on the computer. For example, this technique allows measuring the amplitude of the oscillation as small as 1/100 of the size of a single atom.

It has been found that in many respects drosophila heart problems are rather similar to human ones. This makes drosophila hearts a good model to study the techniques of ultra-sensitive sound profiling. To examine drosophila hearts, it is important to clearly visualize a beating drosophila heart. The AFM is connected to an optical microscopy, which allows us to locate the heart and position the AFM probe directly over it and measure its vibrations. This way we can get a clearer reading using AFM. This method will be used for both healthy drosophila and drosophila with a known heart defect. Comparing these two sets of data, we will correlate the difference in the spectra of the recorded oscillations with the heart disease. Here we also describe the difficulties in sample preparation and the method for the visualization of drosophila hearts.

Locking Magnetic Particles

Matthew Kahabka

Dr. Yuri Roiter & Dr. Sergiy Minko

Chemistry and Biomolecular Science

The field of colloidal science has been continuously growing and adapting to accommodate creative new applications in the field of chemistry and medicine. Recently, the synthesis and characterization techniques of nanoparticles have rapidly developed indicating the importance of organizing those particles into various assemblies to obtain novel properties, which may arise from their 2D and 3D arrangements. The task at hand is to stably lock magnetic nanoparticles together in linear chains in poly(ethylene glycol) (PEG) for the medical and fundamental research purposes. To accomplish this, nanoparticles (150-200 nm) with a superparamagnetic core were synthesized and mixed polymer brushes were grafted to the surface. Prussian blue nanoclusters (7 ± 3 nm) were introduced into the system to accomplish the locking effect in PEG. The particles were stabilized due to the steric repulsion mechanism provided by the outer shell of the polymer brush. This steric repulsion could be overcome by the application of an external magnetic field, effectively locking the magnetic particles in a linear arrangement due to the strong interaction between inner parts of mixed polymer brush. This locking effect can be destroyed by exposure to heat, depending on the concentration of particles and the molecular weight of the solvent, the breaking point of the chains will vary. One of many proposed applications of this technology is the destruction of cancerous cells by means of magnetic hyperthermia. Advancement in this area of technology could have unprecedented ramifications in field of medicinal and colloidal science.

Development and Optimization of ‘Smart’ Biosensors for Assessment of Different Injuries

Fiona Moseley

Jan Halánek, Vera Bocharova, Joseph Wang & Dr. Evgeny Katz
Chemistry and Biomolecular Science

The urgent need for fast, efficient and reliable detection of different injuries at the moment of their occurrence pushes scientists to seek new and more efficient methods. The main direction of our research is the development and optimization of enzymatic cascades for fast and reliable detection of injuries. The main difference from the conventional enzymatic assays is that our inputs are the biomarkers which are incorporated in the enzyme-based cascade tuned to give an output signal only when a specific injury has occurred. In spite of the fact that each of the biomarkers may not be specific to a particular injury, they are overlapping in their specificity in their simultaneous presence in elevated concentrations following a trauma. We have demonstrated that liver injury (LI), soft tissue injury (STI) and abdominal trauma (ABT) can be detected using this approach. The systems produced optically measured alert output signals as “YES” or “NO” separated by a threshold value. The developed system would reliably detect injury biomarkers and decrease the time needed to make crucial decisions for medical intervention, especially in the field. The enzyme catalyzed reactions performed Boolean AND/NAND logic operations in the presence of varied combinations of injury biomarkers allowing for clear and specific biosensing. The effectiveness of the system was confirmed in final in vitro experiments in human serum solutions which suggest that it will work in real medical samples.

Chemoselective Preparation of Protein Conjugates

Anthony Gebo

Remia P. Narayanan and Dr. Artem Melman

Chemistry and Biomolecular Science

Protein conjugation through covalent attachment of chemical compounds to proteins has been the conventional approach toward their utilization in a vast array of functional assemblies. The proposed research involves development of a new method for protein conjugation using chemoselective alkylation of imidazole functions of histidine residues with Baylis-Hillman esters. Thus, understanding the chemoselectivity of Baylis-Hillman esters with side groups of amino acids is a major goal of the project. The chemoselectivity will be determined through measuring the relative rates of reactions for histidine, cysteine, lysine and tyrosine residues with Baylis-Hillman esters using HPLC.

Optimization of Enzyme Crosslinking for Combined Hydrolysis and Fuel Ethanol Fermentation Applications

Daniel J. Horn

Chemistry and Biomolecular Science

Fuel ethanol production is a costly and time consuming process. The purpose of this study was to determine and enhance the effectiveness of ethanol production by utilizing crosslinked enzymes and to optimize the fermentation of sugar into ethanol. The process uses two enzymatic hydrolysis steps followed by yeast fermentation and ethanol separation. The main focus was on the development of crosslinked protein-enzymes which were reacted with a sugar solution in order to compare the crosslinked solution with a standard solution. The crosslinking procedure began when an enzyme and a protein were combined and reacted for a period of time with a crosslinking agent. The crosslinked enzymes were eventually harvested and ground to micron size. A sample of each powder was placed into a dextran solution and allowed to react for a period of six hours; once the reaction was completed, sugar analysis was conducted. The effort made to achieve enzyme particle reactive activities has resulted in the determination that crosslinking for one hour versus five hours had no significant difference in the amount of product yielded. With these results in mind, it can be concluded that crosslinking an enzyme with a protein will be more efficient in sugar production in order to efficiently produce ethanol.

Development of a Nanoparticle based Enzymatic Biosensor for Sensitive Detection of Dopamine

Lynn Lescarbeau & Jason Hultgren
Math and Science Partnership Program
Dr. Silvana Andreescu, Dr. Stephanie Schuckers &
Dr. Kenneth Wallace

The goal of this study is to develop a stable enzyme biosensor for the detection of phenolic compounds, including dopamine with high sensitivity and selectivity. Mathematical models were developed for signal processing and data analysis to increase the sensitivity of the measurements. The technology is based on the use of tyrosinase, an enzyme that catalyzes conversion of phenolic compounds to their quinone derivatives and on the use of redox active gold and platinum doped ceria nanoparticles to provide increased catalytic efficiency and conductivity. Cyclic voltammetry and direct current potential amperometry have been used to characterize and optimize the biosensor. The method was applied for the detection of trace levels of the neurotransmitter dopamine. To enhance effective data analysis and improve accuracy of our analytical process, an algorithm was designed and implemented to evaluate the raw data and determine electrical current levels produced from analytes for each concentration increment. The sensor will be used in future studies to determine in vivo levels of phenolic neurotransmitters.

New Template-Assisted Techniques to Produce Superhydrophobic and Superoleophobic Surfaces

Laura Zielewicz

Chemistry and Biomolecular Science

Surface modification and the study of the wettability of surfaces is a widespread field in nanotechnology. This research project focuses on experimenting with new facile techniques to produce surfaces with superhydrophobic and superoleophobic properties through the utilization of specially designed polymeric porous thin films (membranes) as lithographic masks. This proposed methodology might be useful in creating surfaces with textures on the nano-scale that are not visible to the human eye. The methods include the fabrication of a polymer membrane with nanometer-sized pores via phase separation and its use as a mask for chemical etching of a silicon wafer through the pores in the membrane to produce voids in the silicon. The membrane mask is made of a crosslinked polymer which can be swelled using specific chemicals. The membrane swelling leads to the shrinking of the pore size. The resulting structure is then represented by large voids in silicon covered by the membrane with small openings. In the next step, a negative replica of the structure is created using a fluorinated polymer. The polymer replica has mushroom-like posts on its surface which render the surface with special wetting properties. The water and oil wetting properties of the replica are tested by measuring the contact angles of liquid droplets on the fluoropolymer surface. Atomic Force Microscopy (AFM) is utilized in the visualization of the substrate in each step of the procedure and a Scanning Electron Microscope (SEM) is used to visualize the developed surface. The goal of this project is to create an engineered surface with nano-size structures that demonstrates superhydrophobic and superoleophobic properties for the potential use in self-cleaning and anti-smudging coatings.

Alkali-Activated Concrete: Alkali-Silica Reaction

Rose Kennedy

Civil and Environmental Engineering

This research explores the properties of Alkali-Activated Concrete, in hopes of replacing normal concrete, made with cement. Alkali-Activated Concrete is much more environmentally friendly concrete since it produces less CO₂ and used low energy. Specifically, this research focuses on Alkali-Silica Reaction (ASR) occurring in Alkali-Activated Concrete. Alkali silica reaction is a chemical reaction between alkalis (Na₂O and K₂O) present in the Portland cement and amorphous silica present in some of the aggregates and causes expansion and damage in normal concrete. Alkali-Silica Reactions occur in normal concrete which has much lower concentration of Alkali than Alkali-Activated Concrete. In normal concrete slag and fly ash are used as supplementary cementing materials to mitigate the ASR whereas slag and fly ash are the main starting material in alkali activated concrete. Thus it is nearly impossible to predict whether or not Alkali-Silica Reactions will occur. In order to see if this reaction will occur in Alkali-Activated Concrete ASTM 227 test and ASTM 1260 test were performed on alkali activated concrete. These are the two standard test methods that are used for evaluating the potential of ASR in normal concrete, so they were used for Alkali-Activated Concrete. According to these standards if there is an expansion of more than 0.1% after exposing the concrete to a specific environment, then the reaction has occurred, if it is less then there was no reaction. The results will also be compared with normal concrete.

Hydrothermal Vent Chemical Composition Available for Mining in the Presence of Tube worms (*R. pachyptila*)

Erika Chin

Civil and Environmental Engineering

Hydrothermal vents have been considered the new frontier. The mid-ocean ridge spanning Earth's surface for 42,000 miles contains thousands of hydrothermal vents whose hot fluid can be harvested for material, pharmaceutical, and energy purposes. Minerals such as gold, iron, copper, and zinc are now recognized as being formed on the ocean crust which can also be a source for manufacturing and industrial applications. Furthermore, this toxic sauna highly concentrated in hydrogen sulfide provides the source of energy for bacteria that produce the food and nutrients necessary to sustain an abundance of unique species in the absence of sunlight. These organisms contain the enzymes necessary to improve techniques to combat iron deficiencies and create new drugs. Finally, the heat from the vents, which can reach temperatures up to 400°C, can be used as an alternative energy source. Ultimately, this study analyzes the chemicals required for biogeochemical processes to sustain the organisms and their environment in order to calculate the amount of vent fluid available for future harvesting.

Graphical User Interface for a Laser Induced Breakdown Spectroscopy system using Mat-Lab

Jason R. Hollander
Electrical Engineering

Laser-Induced Breakdown Spectroscopy (LIBS) is a method for measuring the chemical composition of a material by generating a plasma with a high-energy laser pulse and observing element-specific emission lines across the ultraviolet, visible, and near infrared spectrum. The large number of settings and parameters that must be set by the operator complicates testing the laser system when it has been calibrated. With the help of Mat-Lab and utilizing the aVantes spectrometer and its HD-26 data pins a simulated control panel for the Class 4 Laser can be generated using a Graphic User Interface or GUI. To be able to use the aVantes in Mat-Lab the shared library file must be imported into Mat-Lab. A prototype of the GUI has been made which future goals is to have all the system components operated automatically at the press of a button. The components include two cameras, two moving stands, focusing laser, the class 4 laser, and the spectrometer.

Avian and Anuran Diversity of Restored and Natural Wetlands in the St. Lawrence Valley of New York

Laura Barlow¹

Jeremy Ozolins²

Dr. Tom Langen

Catherine Benson

Biology

Government agencies and non-profit organizations use wetland restoration as a conservation tool to compensate for past and present losses of wetland habitats in the U.S. The US Fish and Wildlife Service Partners for Fish and Wildlife Program (PFWP) and US Department of Agriculture National Resource Conservation Service Wetlands Reserve Program (WRP) provide incentives to private landowners to restore and protect wetland habitats. The problem is that wetland restorations are not studied after their completion and little knowledge exists regarding how well restorations function compared to naturally occurring wetlands. The objective of this study is to assess bird and anuran diversity at 33 PFWP and WRP restorations and 15 natural sites in the St. Lawrence Valley of New York. Bird surveys were conducted twice in the month of June using standard point counts and playback vocalizations. Frog and toad surveys were conducted three times (April-June) by sampling night time choruses. Anuran data collected during 2009 and 2010 indicates no difference in species richness and chorus size between restored and natural sites. Additionally, we found no difference in bird species richness between wetland types, however natural sites supported significantly more wetland dependent bird species. Data collected in 2011 is currently being analyzed and will be presented along with 2009 and 2010 data at the SURE Conference.

Evaluating Fence Barriers for Preventing Turtle Road Mortality

Cory Symonds
Biology

Roads that travel between or through wetlands are a significant risk to turtle populations in the northern New York region. To reduce these roadside mortalities fences were installed at sites recorded to have significant turtle traffic. Surveys of turtle deaths, nests, and traffic along these fenced areas are being monitored against nearby control sites to conclude whether or not this form of prevention is adequate. These surveys include GPS recording of the deaths, nests, and traffic to provide mappings for data presentation along with temperature sensors to correlate development with the temperature changes that roads have on the immediate environment. Turtle fences have been a collaboration between Clarkson University and the Department of Transportation in order to provide a safer habitat for motorists and wildlife.

Feasibility Analysis - Utilizing Waste Resources at DANC's Rodman Landfill for Algae Biodiesel Production

Ryan Esposito and Daniel Hanczyk
Chemical Engineering and Engineering and Management
Dr. Michael Twiss and Dr. Susan Powers
Biology and Environmental Engineering

Recent history has proven that the need for alternative, renewable energy is a growing necessity. There have been countless efforts around the globe pertaining to this issue. One idea, in an effort to reduce the demand for diesel, is to produce microalgae and use its oil contents to produce biodiesel. Microalgae can produce a surprisingly large amount of oil and have recently been considered the second generation biodiesel because of this valuable characteristic. The objective is to do a preliminary design and financial feasibility analysis of a biodiesel production facility at the Development Authority of the North Country's (DANC's) Rodman Landfill. In order to achieve these objectives it first needs to be determined the exact oil contents of the microalgae and how fast the microalgae grow. To determine how fast the microalgae grow a Coulter Counter is being used. This growth information provides useful statistics for the design of a photobioreactor. A continuous flow photobioreactor is designed for harvesting microalgae. The research also entails designing an extraction process to extract the oil contents of the microalgae and a transesterification process to convert the oil to biodiesel. The microalgae to biodiesel process design will be conducted, primarily, using mass and energy balances. The goal is to produce enough biodiesel to supply the landfill with 20 percent of the current diesel demand. The financial feasibility analysis will be based on the aforementioned research and includes price of equipment, price of raw materials as well as heating and energy demands.

Evaluation of the Sampling Bias Associated with a Capillary Flow Controller-Canister Air Sampling System

Jillian Brown

Institute for a Sustainable Environment

Environmental Health Science Program

In recent years, a growing number of studies have suggested a link between indoor air quality and general health, exposure to commonly used hazardous chemicals has been seen to cause short or long term health effects in individuals. Effective air sampling techniques are continually developed to adequately assess individual's exposures and ensure minimal risk. The focus of this study was to evaluate any potential sampling bias associated with use of the capillary canister for collecting personal air samples. A bias is anticipated because the flow rate changes slowly over the sampling period, therefore varying amounts of the contaminant are collected, given the concentration profile in the sampling environment. Using a dynamic dilution system, known concentrations of toluene were generated inside a small enclosed chamber. Four capillary canisters were filled during a four hour sampling period inside the chamber while direct injections were taken using a gas chromatograph (GC). The chamber concentrations were developed to simulate a background level of contaminant with peak exposure durations at specified amplitudes, either 10 or 100 times above the background concentration. This method was used to evaluate the canisters' ability to perform long term exposure assessment in areas of fluctuating concentrations. After the data was collected, a bias was determined by comparing the capillary canisters to the GC values. The bias was found to be relatively constant (~ 20%) for the 10x amplitude peaks and showed an increasing bias was found for the 100x amplitude depending upon the peak location within the sampling period.

Understanding the Impact of Catchment Basins on Berry Farming in the Pajaro Valley

Jessica D. Burl
Mathematics

Within the past half century, the Pajaro Valley has been experiencing problems with a severe extraction of water from underground aquifers below the valley. Berry farming is known as one of the major industries in the valley, but unfortunately, it is believed to be one of the leading causes of imbalanced water sustainability due to the use of ground water for irrigational purposes. It is important and necessary to search for ways to mitigate the amount of water drafted out of the aquifers to achieve a sustainable water state in the Pajaro Valley. A virtual farm tool is already in place for comprehension of the impact of rotating planting scenarios and crop management choices. A catchment basin is designed to infiltrate storm water run-off through permeable soils into the ground water aquifer or to infiltration facilities to be recycled. In this research, information about catchment basins was obtained and applied to the already existent mathematical models that simulate an artificial berry farm with realistic cost and water usage parameters. The goal is to minimize the total aquifer depletion and maximize the profits of the berry farmers in the valley by finding optimal crop rotation schedules given supplementary water from catchment basins.

Ultralight Vacuum Chamber for use in Airship Design

Robert Johnson

Mechanical and Aeronautical Engineering

Modern vacuum chambers are large and heavy pieces of machinery, and because of this few people would believe that a vacuum chamber could fly. Vacuum has the potential to be the best lifting agent possible as the efficiency of a buoyancy lifting agent is determined by the difference between the density of the lifting agent and the medium it is in, and nothing is less dense than a vacuum. The creation of a vacuum chamber light enough such that the weight of the air displaced is greater than the weight of the chamber has been thought about for a long time, but so far no one has made a working model of one. The purpose of this research is to try to design and build a model of a vacuum chamber that is light enough to fly or can be scaled up to gain that ability. The model shall be designed using advanced composite materials and novel geometric principles in order to cut down on weight and make the model as strong as possible. If a working model is found it would have a large impact on the aviation industry as it could herald a return of the airship as a viable means of transportation.

Transient Wind Behavior Effects on Wind Turbine Power Output

Andrew Salisbury

Dr. Kenneth Visser

Mechanical and Aeronautical Engineering

This project investigates the difference between an average wind turbine power curve and the actual power output of a wind turbine. Wind energy is becoming a significant part of the renewable energy sector, consisting of 1.9% of the total demand for electricity in the United States in 2009.¹ To further develop wind turbine technology, and to determine its continued potential as a significant energy source it is necessary to determine the actual power potential of wind turbine systems.

To determine the actual power output of a wind turbine, experimental analysis will be conducted on a diffuser augmented wind turbine, developed by WindTamer and Clarkson University, at the Clarkson University wind turbine test site. The first step in this project is to collect experimental data at the test site. Data will be taken on the meteorological conditions, including wind speed, wind direction, pressure, humidity and temperature at one second time intervals. Also data on the voltage and current of the wind turbine will be taken at one second intervals to determine the instantaneous power output. The final step in this project is to create a data analysis code. This code will compute the actual power output of the wind turbine. This will be compared to the average power curve to look into the difference between the two.

Induced Drag Reduction with the Addition of Raked Tips

Julian Corpus

Mechanical and Aeronautical Engineering

The focus of the research is to determine the cause of past experimental data which showed a drastic reduction in the induced drag values as compared to other induced drag reduction techniques. Different Raked Tip geometries are being designed so that they may be attached to a model and tested in the Clarkson University High Speed Wind Tunnel under similar conditions that the initial tests were conducted under. Using MatLab in conjunction with Excel and Xfoil wingtip geometries are created to be imported into Autodesk Inventor so that they can be edited to allow for their construction in the 10" by 10" by 10" stereolithography machine. A model fuselage will be created as well as the use of pins and a metal rod to help stabilize the tip attachments to the wing and fuselage. After construction is completed they will be tested in the wind tunnel collecting data using 7-hole probe in the wake field. The data will be analyzed using a wake analysis code to determine the different components of drag. The varying raked tips will help determine what aspects of either the previous research or varying Raked Tip Geometries causes the drag reduction. This research is valuable because induced drag is a result of a plane in motion and reductions in this would allow for better fuel efficiency during take-off and landing.

Venturi Effect Vertical Axis Wind Turbine

Hassan Razak

Bereket Ghebreselassie

Aeronautical Engineering

The need to meet the rising demands of energy and to keep our planet clean is one of the biggest problems that our scientist's face today. That is why more sustainable and renewable sources need to be used. Wind turbines are the key to this energy. Venturi Effect Wind Turbine helps increase the production of energy and yet at the same time be environmentally friendly. This VEWT's has a vertical axis and is shaped with a 180 degree twist. This design is crucial for producing wind energy. The effects of the success of this experiment are monumental.

Lift Generation on an Airfoil in a Semi-Closed Pipe

Nateenond Supatpitak

Mechanical and Aeronautical Engineering

In this work, lift generation of an airfoil enclosed in a semi-closed pipe system is studied. The approach will investigate the different models where each will have different opening locations. The openings will either be above or below the airfoil or a combination of both. The model will be very small using a 15 cm diameter propeller and wing span. Preliminary calculations using low Reynolds number and with same dimensions suggest that using the airfoil will actually generate about three times less force than air flowing directly towards the ground. However, the airfoil setup does have advantages in the variables that could potentially increase its efficiency over the conventional system. Also using a semi-closed pipe system will reduce the undesired exhaust flow created by forcing the air downwards. Initial model will investigate the lift generated from the airfoil without boundaries and will be used as a benchmark to compare the efficiency of other setups. Then two models where the openings will be above and below the airfoil will be tested for its efficiency. Lastly a model with both openings will be tested. In each model the area of the openings will be varied to investigate its effect on the lift generated on the airfoil.

Load Frame Fixture for Medial Ulnar Collateral Ligament Testing

Bubah Conteh

Mechanical and Aeronautical Engineering

The medial ulnar collateral ligament (MUCL) is located in the elbow joint and is essential to everyday life. Injuries to the MUCL are often experienced by athletes; even after surgery many cannot fully recover. The Tommy John surgery which repairs the MUCL, is a common surgery for baseball players. The long term objective of the present research is to find the mechanical properties of the MUCL by subjecting it to different forces using a load frame. Knowing these mechanical properties can help surgeon's better repair damaged ligaments. The ligament's delicate composition makes it difficult to attach directly to the load frame. The uniaxial load frame only applies loads in one direction. This project will design a fixture to attach the ligament onto the load frame so that multidirectional, physiologically realistic, loads can be applied. Being able to apply a multidirectional load to the specimen is very important in this project. A multidirectional load will allow us to simulate the forces the MUCL is subjected to in everyday life. During the design process a previous model of the fixture was evaluated on AutoCAD. A 3D model of each individual piece was designed and assembled on Pro/ENGINEER (see in Fig 1). The parts of the fixture will be constructed with aluminum making it light weight and easy to clean. The fixture is currently being built by the machine shop staff. In the future we hope to use the fixture to test other ligaments for the mechanical properties that associate with them.

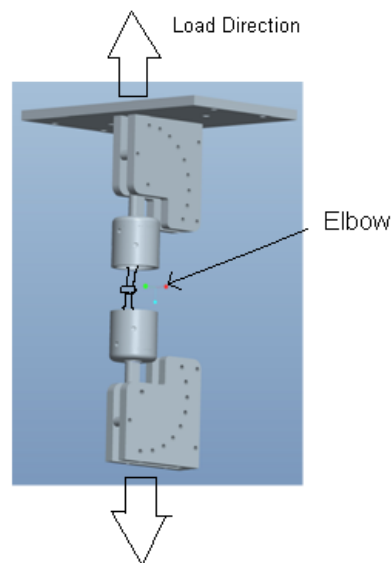


Fig 1-Load frame fixture

Drag Reduction on Aerodynamic Shapes with Ground Effect

Brian Hilbert

Mechanical and Aeronautical Engineering

Boundary layer separation from bluff bodies in ground proximity significantly affects many problems of practical importance such as the intensity of reaction forces (e.g. drag), vibrations and noise, and efficiencies of heat/ mass transfer. This study focuses on the reduction of drag on a circular cylinder in ground effect through the use of passive flow control techniques. Passive flow control is a means of deterring boundary layer separation through flow regime manipulation. Passive flow control methodologies will be studied to reduce drag for a range of Reynolds numbers to mimic the varying operational loading of practical geometries (e.g. aircraft wing). Flow control devices trip the boundary layer to turbulence, increasing surface momentum and promoting flow attachment. Boundary layer trips of varying geometry will initially be considered with more complex controls applied throughout the evolution of experimentation. Flow control techniques will be optimized for drag reduction through wind tunnel testing. Results obtained from the current study on a circular cylinder will be applied to more practical shapes such as airfoils and racecar wings in an effort to reduce drag and increase the fuel efficiency of transport vehicles.

Vortex-Shedding from Rectangular Plates in a Cross Flow

Joseph Fremante
Mechanical and Aeronautical Engineering

A famous bridge failure was that of the Tacoma Narrows Bridge. There was nothing wrong with the main structure of the bridge but that didn't stop it from swaying back and forth in the wind until the oscillation reached the frequency of the bridge causing it to collapse. When the wind blows across the bridge deck it causes vortex shedding. This unsteady flow induces unbalanced forces on the bridge deck and is caused when the air flow hits the blunt edges of the deck. What has been done to prevent this from occurring is the testing of different shape bridge decks in a variety of cross flows. This makes it possible to decide what shape will do best with certain winds to cause the least vortex-shedding. The basic shape of most bridge decks is a rectangle. Through testing a rectangular plate in cross flows allows to give a general understanding of how a bridge deck reacts from the forces it experiences. This testing was done computationally through a program called Ansys Fluent. Using the program Ansys Gambit a two dimensional rectangle can be created to be used in Fluent which gives the rectangle a depth and is then tested in a computational air flow of any given fluid. With this testing it can be further understood how the vortex-shedding forms and its effects on the rectangle.

The Clarkson University UAV

Juan Gonzalez
Daniel Valyou & Dr. Pier Marzocca
Aeronautical and Mechanical Engineering

UAV (Unmanned Aerial Vehicles) are a growing division in the aeronautical industry. These vehicles provide many purposes, military, research, and commercial uses. The UAV that is currently in the construction process will participate in future research campaigns, air quality analyses, wind profiling, etc. The aircraft has been designed to take advantage of advanced materials that will allow us to produce a lighter and more durable aircraft. Its components manufactured from composite materials made from fiberglass cloth, carbon fiber, chopped strained mat, and using epoxy resin. Once fabrication and assembly is completed, structural and flight-testing will be performed in compliance with FAA regulations. The presentation will discuss the design, aircraft production and its certification.

Rotating Flows & Cylinders: A Simple Mixing Device

Sarah E. Mead

Mechanical & Aeronautical Engineering

Cylindrical mixing devices with a rotating impeller are used throughout the chemical and biological processing industry. For relatively viscous fluids, axisymmetric configurations are recommended in the mixing device design literature. Flow visualization experiments provide the means to observe parts of the vortex flow patterns in a cylindrical container induced by a rotating disk as illustrated in the figure below. The device illustrated is the simplest model of such devices used to stir fluids. The flow-visualization experiment performed was to examine the rotating flow created by the disk at a Reynolds number between 2000 and 2500; the flow field of interest was observed in the bottom of the cylinder with the disk located about one diameter from the bottom. To control the viscosity of the fluid, a mixture of water and glycerol is used. This experiment allowed us to observe a phenomenon known as vortex breakdown. To observe the breakdown phenomenon, potassium permanganate was used. The observations will be compared with results from a numerical simulation. This comparison will allow us to examine the quantitative details of this flow. The implications of this phenomenon on mixing will also be discussed.

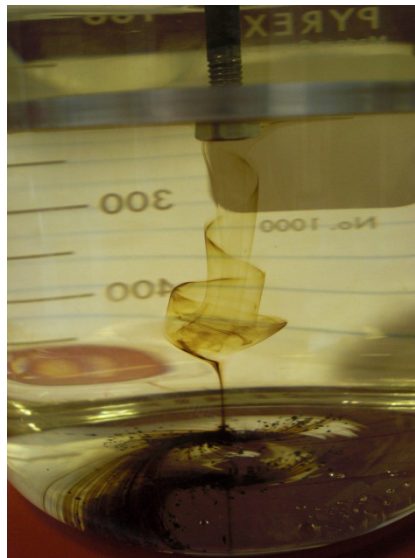


Figure 1: Flow visualization in a rotating-disk stirred tank.

Prediction and Verification of Young's Modulus for a Composite Laminate

Ruisheng Wang

Dr. Ratneshwar Jha

Mechanical and Aeronautical Engineering

Composite materials such as carbon-fiber composites are employed in high performance applications due to their light weight, high specific strength and high stiffness. These properties of composites can be analytically predicted via micro- and macro-mechanics. In micro-mechanics, a lamina is broken down and examined based on its constituents, that is, the reinforcement and matrix. Once the lamina properties have been ascertained, laminate level properties can then be predicted through macro-mechanics. Based on given material properties for AS4/3501-6 pre-preg lamina, Young's modulus for an eight-ply laminate was calculated. The stiffness matrix of a single lamina is transformed from material to global axis system and is then integrated through the thickness of the laminate to obtain the extensional stiffness matrix. In order to verify the laminate modulus, Lamb wave phase velocities were utilized. If the velocity of a wave propagating through a material is known, then material properties such as the elastic stiffness (one of the factors which affect wave propagation in materials) can be subsequently calculated. In this experiment, Lamb waves were propagated through an eight-ply carbon-epoxy composite laminate and data was collected using piezoelectric (PZT) sensors and a scanning Laser Doppler Vibrometer. Finally, the analytical Young's modulus for AS4/3501-6 carbon-epoxy laminate was verified using the experimental data.

Lagrangian Coherent Structures in the Wake of an Oscillating Airfoil

Tancy Thomas
Mechanical Engineering

In this work a dynamic systems approach is taken to analyze the wake of an oscillating airfoil. Molecular Tagging Velocimetry is used to quantify the flow field in the wake of a NACA0012 airfoil oscillating at low amplitudes and high reduced frequencies. Finite Time Lyapunov Exponents (FTLE) are computed from the experimentally derived velocity fields to determine the Lagrangian Coherent Structure (LCS) fields for the flow. These structures are used to highlighted the regions where mixing can occur as well as barriers to fluid transport between regions in the flow. The LCS fields are then compared to the vorticity fields to determine how these two descriptions of the flow fields compare.

Early Environment and Life-History Variables

George Apau^{1a}

Amanda Sherman^{2b}, Steve Minich^{3b}, Dr. Tom Langen^{2,4}, Dr. Joseph Skufca³ &

Dr. Andreas Wilke²

¹Biomolecular Science

²Psychology

³Mathematics

⁴Biology

^aMcNair Scholars Program

^bITiMBReaC Undergraduate Training Program

Humans internalize environmental cues at an early age, which influences their subsequent risk-taking behavior. In the current study, we examined the effects of several life-history variables and early environmental factors on an individual's risk propensity in past and present environments. Our methodology measured subjective likelihoods of engaging in risky behaviors in ten evolutionarily valid domains of risk, including between-group competition, within-group competition, status, environmental challenge, food selection, food acquisition, parent-offspring conflict, kinship, mate attraction, and short-term/long-term mating strategies. We expected that individuals who were exposed to high-risk environments in childhood would be less inclined toward risky behaviors than individuals who grew up in less dangerous areas.

Factors Affecting Psychosocial Attributes in a Sample of Clarkson Students

Sarah Andres and Hosana Mamata
Psychology and Mathematics

Caffeine is the most widely used psychoactive drug in the world. Previous research that examined the potential negative effects of the overuse of this drug, including heartburn, insomnia, and heightened anxiety (Griffiths & Woodson, 1988), has shown that caffeine consumption may be correlated to the psychosocial status of college students. One objective of this study was to see what effects, if any, caffeine consumption had on depression, state anxiety, and stress levels of Clarkson students. A second objective was to examine the relationship between the previously listed psychosocial attributes and the participants' reported average hours of sleep and quality of rest.

In Phase I of this study, cross-sectional data was collected via survey from participating students in an Introductory Psychology course at Clarkson University. Phase II of this study examined longitudinal data on sleep, caffeine consumption, and psychosocial factors over an 8-week period of time from a subset of students from Phase I.

Mixed effects models were used to determine the association between predictor variables of caffeine consumption, average hours of sleep, how rested the participant felt, age of the participant, and sex of the participant, and response variables of stress, anxiety, and depression. Data analysis showed a stronger correlation with stress, anxiety, and depression for average hours of sleep/how rested the participants felt versus the amount of caffeine consumed.

Investigating the Effectiveness of Accommodative Programs Designed to Assist People with Non-Visible Disabilities: Comparing Services in High School to those in College and the Workplace.

Christa Harper
Psychology

According to existing literature (primarily noted in the Journal of Learning Disabilities), several non-visible disabilities (e.g. learning disabilities) are often “hidden, ignored, and unwelcome.” This differs from the treatment of visibly physically disabled students. Additionally, laws protecting disabled college students diverge greatly from laws protecting disabled high school students. The current stage of research examines interview processes to be used in the upcoming semester with school administrators, students with hidden disabilities, and local companies that hire graduates. This research will provide a better picture of existing conditions, the effectiveness of legal requirements, and proposed solutions to potential common shortcomings identified.

Human Center of Pressure Response to Sinusoidal Movements

Kathryn Kearns¹

Dr. Charles Robinson²

1 –Chemical & Biomolecular Engineering, 2 – Center for Rehabilitation Science, Engineering & Technology

Visual cues from the surrounding environment are one main input for balance and postural control. To determine the significance of this input, the psychophysical, postural and lower limb electromyographic (EMG) responses of four quietly standing young adult subjects viewing a patterned visual scene were tested when either they or the scene was sinusoidally oscillated at 0.33, 0.5 and/or 0.67 Hz in the anterior-posterior direction. Subjects also signaled whether or not they could detect the move in order to determine a psychophysical movement detection threshold. Data collected during these experiments were used to determine how the anterior-posterior center of pressure (APCOP) changed for each subject during the oscillations. It was found that when subjects were standing and the vision board was moving, each subject's APCOP became locked in to the platform movement. It also was found that these responses were almost exactly 180 degrees out of phase with the movement. Subjects' APCOPs changed the same way even if they could not correctly detect a move. Twenty out of thirty trials at each frequency were run where the platform was oscillated. For control, ten trials were null trials where the platform remained stationary. In the future, more subjects will be tested to verify this locked-in reaction. Motion-capture-marker and EMG data will be also analyzed to more accurately understand the body's responses to these oscillatory visual perturbations.

Analyzing the Biomechanical Responses of Blindfolded Humans to Large Horizontal Anterior Perturbations of a Sliding Platform

Frank Hemsing

Dr. Charles Robinson

Mechanical and Aeronautical Engineering

Falling can cause injury in the elderly and disabled, as well as the able-bodied. The mechanisms that contribute to falls in humans are therefore of considerable interest to rehabilitative and biomedical engineering. Determining how an individual responds to a disturbance in balance is valuable in assessing an individual's risk of suffering a fall. This study focused on three related aspects of the response to a sudden forward motion: the neuromuscular response to the perturbation, the unconditioned biomechanical sway response, and the subject's accommodation to moves occurring after the first perturbation. After giving informed consent, 46 individuals were asked to stand on the SLIP-FALLS sliding platform. Two perturbation cases were investigated in this study — ten trials of a subtle 4 mm anterior move at 100 mm/s^2 , and three trials of a large and rapid 50 mm anterior move at 1000 mm/sec^2 . Changes in sway in response to these moves were assessed by measuring changes in each subject's anterior-posterior center of pressure (APCoP). Surface electromyogram (EMG) responses were taken from the tibialis anterior, gastrocnemius, and soleus muscles. The response latency of motion detection was recorded by having subjects press a button when they felt that the move occurred. On average, all subjects exhibit a characteristic APCoP response to the larger perturbation consisting of an initial posterior excursion against the perturbation, a forward displacement to correct for that motion, and a final posterior excursion due to overcorrecting. Different cases of these responses have been identified and their relation to EMG measurements was investigated.

Development of an Electromechanical Actuator for a Powered Prosthetic Leg

Maurice Patrick

Mechanical and Aeronautical Engineering

The objective of this research project is to contribute to the advancement of actuation technology for use in transfemoral (above knee) prosthetic limbs. The integration of power and actuation at the knee joint will provide functionality approaching that of a biological knee joint. A motor driven linear actuator has been designed to provide the output energetics required for locomotion, offering the potential of restoring limb function lost due to amputation. The work presented here will detail the design, fabrication and preliminary bench top experimental characterization of the prototype actuator.

Medicine in Reverse: Chemistry for Binding Overdosed Chemicals

Elizabeth Callow, Sean Parnett & Elizabeth Waters
Meghan Himmler, Steve Prescott & Dr. Richard Partch
Chemistry & Chemical Engineering

Serious health consequences frequently arise from accidental overdoses of injected or ingested chemicals. This problem occurs not only with unwise use of illicit chemicals like cocaine and methamphetamine but also with several prescription therapeutics delivered into the body by medical personnel or taken by patients. Some of the latter chemicals if taken in overdose are local anesthetics and antidepressants which cause cardiac arrest, and analgesics like Tylenol which damage the liver.

During the past several years members of the Partch group at Clarkson, in collaboration with medical and engineering faculty at the University of Florida, have researched potential antidotes for reducing overdoses of the types of chemicals mentioned, all of which contain a benzene ring as part of their molecular structures. The successful studies include using the concept of charge transfer complexation between a so-called pi-acceptor benzene ring, designed to bind and deactivate the dangerous biological effect of the overdosed chemical, and the pi-donor feature of the benzene ring in the overdosed molecules. This work has been published.

During the summer of 2011 the authors of this poster have each researched new applications of the pi-pi bonding concept to 1) determine if the antidote concept can be applied for binding the dangerous methamphetamine, now known to be causing numerous deaths due to overdoses, 2) determine if time-dependent infrared spectral data can give kinetic and equilibrium pi-pi bond information, and 3) evaluate whether ultra violet or visible spectral data can be used to determine the efficiency of binding different isomeric forms of dimethylaniline pi-donor to known pi-acceptors.

Data and conclusions from the recent work are presented on the poster.