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UNDERGRADUATE RESEARCH ABSTRACTS

Poster Session - September 8, 2011

10 a.m. – 2 p.m.

Student Center Atrium

Supported by the Office of the Provost

Making Sense of Cleveland's Past: The Archaeological Collection from the 'Mall A' Construction Site, Cleveland, Ohio

College of Liberal Arts and Social Sciences

Department of Anthropology

Student Researchers: Michael Agnich; Kerianne Armelli; Sarah Arth; Emily Bettin; Adena Muskin; Dick Powis; Valentine Volk; Vanessa Willaman

Faculty Advisors: Dr. Paul L. Aspelin & Dr. Phillip J. Wanyerka

Abstract

A collection of artifacts originally excavated in 1988 from the southernmost section of the Cleveland Mall has become available for undergraduate archaeological research. Through extensive target sampling, artifacts that are historically revealing have been studied in order to gain insight on the middle to late nineteenth century cultural identity of Cleveland, Ohio. A desire to link artifacts to people who lived and worked in the residential area predating the Cleveland Mall served as the primary motivation behind this project. Only then can we have a material appreciation for the lives of people that resided in what is now a public park space. Resources included field notes from the original excavations, laboratory notes, and project reports from the Cleveland Museum of Natural History, as well as detailed census information, Sanborn Insurance maps, and books that detailed a comprehensive account of life in Cleveland during the middle to late nineteenth century.

The Substantive Impact of First Lady Policy Activism

College of Liberal Arts and Social Sciences

Student Researcher: Aleksandra Misovic

Faculty Advisor: Justin S. Vaughn, Ph.D.

Abstract

This project analyzes the ways First Ladies have influenced public policy. How presidents determine policy can be better understood with knowledge and understanding of the influence of presidential wives. As First Ladies have become political assets for the presidents' administrations, their proximity to the incumbent provides an advantageous opportunity to ascertain direct or indirect influence over policies and decisions made. Therefore, the first lady has a distinct opportunity to be the president's closest advisor. It is important to evaluate to the extent that first ladies were able to utilize such influence through and unelected office. The research examines the ways historical precedence, institutional momentum, and the individual First Ladies have intersected to contribute to the evolution of the office and the subsequent policy influence of modern First Ladies. I find that when First Ladies act according to societal norms and expectations of women, criticism is rare because it furthers the exemplary status of women. However, when first ladies have challenged societal norms and stepped into the public sphere they have been highly criticized which has halted the progression of the evolution of the office.

Developing a Survey to Serve the Underserved: Physical Therapy Satisfaction at the Free Clinic

College of Sciences and Health Professions

Student Researcher: Beth Ann Miller

Faculty Advisor: Dr. Mary Milidonis

Abstract

The purpose was to develop a survey to understand the needs of individuals utilizing physical therapy services at the Free Clinic of Cleveland. The purpose of identifying these needs was to customize a satisfaction survey tailored to this population. Little is known about the satisfaction outcomes of the services provided by physical therapists and students at the Free Clinic of Cleveland. The core measurement model utilized Donabedian's quality health care paradigm. Methods: A literature search performed through PubMed.gov on unique needs of the underinsured, as well as a literature search through PubMed.gov on physical therapy satisfaction instruments. Four content experts chose and validated the satisfaction model and survey items. The survey was constructed with SNAP Survey Software. Twelve physical therapy users reviewed and responded to the survey items for reliability and validity of the instrument. Results: A moderate to high reliability was found among the survey questions tested with Cronbach's Alpha ranging from .613 to .897. The physical therapy care was rated through 49 questions and four specific dimensions. The next step is to test the survey with individuals who use physical therapy services at the Free Clinic.

Thermally Responsive Polypeptide Nanoparticles: Design and Characterization

College of Sciences and Health Professions

Student Researcher: Kaitlin Vandemark

Faculty Advisors: Kiril A. Streletzky, Ph.D., Department of Physics; Nolan B Holland, Ph.D., Department of Chemical and Biochemical Engineering

Abstract

Elastin-Like-Polypeptides (ELP) are used to synthesize environmentally responsive nanoparticles. These nanoparticles undergo a transition from a soluble state at room temperature to micellar aggregates above the transition. The micelles were characterized using Dynamic (DLS) and Static-Light-Scattering (SLS). Micelle properties were found to strongly depend on salt concentration with several apparent regimes. At low salt (0-15mM) largely spherical micelles were found with Rh=15nm, which corresponds to the size of folded ELP hydrophilic tail. Rh increased 2% with salt concentration in this range. DLS and SLS spectra also revealed presence of non-diffusive formations in low salt samples. At the intermediate salt (15-30mM) the observed particles yielded properties of spherical micelles that increased in size by about 3 fold as salt increased from 15 to 30mM. At the highest salt concentrations (30-60mM), observed micelles behaved as elongated particles with Rh~75nm that corresponds to the size of a stretched ELP chain. The size (by 10%) and elongation of micelles increased with rising salt concentration. Between 0 and 45mM of salt SLS revealed an increase in apparent molecular weight from 400-500kg/mol at low salt to 15000-20000kg/mol at high salt with significant jump centered at intermediate salt regime. We also found that increase in pH from 9.6 to 10.6 resulted in 10% shrinking of elongated micelles at high salt.

Thermally Responsive Polypeptide Nanoparticles: Design and Characterization

College of Sciences and Health Professions

Student Researcher: Ciara Sietz

Faculty Advisors: Kiril A. Streletzky, Ph.D., Department of Physics; Nolan B Holland, Ph.D., Department of Chemical and Biochemical Engineering

Abstract

Elastin-like polypeptides (ELPs) consist of repeats of the pentapeptide GVGVP, where the valine residues can be substituted to change their properties. ELPs exhibit a reversible phase separation above a transition temperature, which is dependent on molecular weight and concentration. This behavior can be used for reversible formation of micellar nanoparticles or in protein purification. Moderate lengths of poly(GVGVP) have transition temperatures >30˚C, however, for many applications it would be useful for the ELP transition temperature to be closer to room temperature. By using different amino acids this transition temperature can be altered. In this study leucine is substituted into the sequence replacing the first valine, which theoretically exhibits a transition temperature of 20˚C lower. Genes have been produced for various lengths of poly(GLGVP) by recursive directional ligation. These genes have been successfully expressed in *E. coli.* Inverse transition temperature cycling is used to purify the ELPs.

Effect of Polymer Molecular Weight and Synthesis Temperature on Structure and Dynamics of Polysaccharide Microgels

College of Sciences and Health Professions

Student Researcher: Krista G. Freeman

Faculty Advisor: Kiril A. Streletzky, Ph.D., Department of Physics

Abstract

Cellulose-based polymer has been used to synthesize environmentally-sensitive microgels. Synthesis was carried out under varying synthesis conditions to study the dependences of microgel dynamics and structure on polymer molecular weight and synthesis temperature. The dynamics and structure of the synthesized microgels both below and above the volume phase transition temperature have been studied using dynamic and static light scattering spectroscopy. All microgels exhibit a volume phase transition above the LCST of the polymer (~41°C) and undergo a reversible 15-50-fold change in volume. The size distribution, structure, and deswelling ability of microgels strongly depend on synthesis conditions. Synthesis temperature dependence was studied with 1000kDa polymer. Increasing $\Delta T = T_{syn} - T_C$ yields smaller microgels with a smaller swelling ratio, up to $\Delta T = 8.5°C$, after which the opposite trend it seen. All microgels synthesized with 1000kDa show a gradual shrinkage with increasing temperature. On the other hand, microgels synthesized with low molecular weight typically yield typically larger microgels which display a delayed and sudden shrinkage. Microgels synthesized with low molecular weight polymer show non-spherical behavior at T_{room}. Generally microgels show signs of elongation, especially at T_{room} for low molecular weights and low synthesis temperatures.

Colloidal Dispersions: Moving Toward Polysaccharide Microgel Crystalline Phase Auto-Assembly at Room Temperature

College of Sciences and Health Professions

Student Researcher: Jacob Adkins

Faculty Advisor: Kiril A. Streletzky, Ph.D., Department of Physics

Abstract

Environmentally responsive microgel nanoparticles synthesized from naturally occurring polymers, such as Hydroxypropylcellulose (HPC), offer potential applications such as controlled drug-delivery, pH sensors, and photonic crystals. For samples of appropriately high concentration, HPC microgels have shown the ability to self-associate into ordered arrays at room temperature (1). This self-assembly of HPC microgel particles corresponds to the phase transition of the colloid from liquid to a crystalline phase with short-range order. In effort to re-create ordered phase from HPC microgel particles several steps were undertaken. First, polystyrene probes were used in an attempt to develop reproducible methods for increasing, characterizing, and directly measuring concentration. Second, spectophometry was mastered for characterizing colloidal dispersions. Third, HPC microgels were synthesized under conditions optimized for near-monodispersity, a necessary condition for self-assembly at room temperature. Fourth, Dynamic Light Scattering has been used to characterize microgel physical properties, including size and polydispersity. Entropically driven phase transition from liquid to crystal in colloidal dispersion of synthesized HPC microgels was not observed because the necessary concentration for self-association was not achieved yet.

Mastering Static Light Scattering on Polysaccharides

College of Sciences and Health Professions

Student Researcher: Sean Sheridan

Faculty Advisor: Kiril A. Streletzky, Ph.D., Department of Physics

Abstract

Static Light Scattering (SLS) is a method that measures mean molecular weight, M_w, radius of gyration, R_g, and second viral coefficient, A_2 for macromolecules from the average intensity of light scattered by them. SLS was employed to study hydroxypropylcellulose (HPC), a non- toxic polymer used in drug delivery applications. Initially, we found the 60kDa polymer sample to have M_w of -403kDa and the new 1000kDa sample to have M_w of 2715kDa. We believe this error was due to excessive dust in the samples so we cleaned light scattering cells carefully. The new 100kDa sample had a measured M_w of 94kDa, the old 100kDa sample had a measured M_w of 238kDa, the 300kDa sample had a measured M_w of 709kDa, and the 60kDa sample had a measured M_w of 161kDa. In this case the error in many measurements probably came due to reusing of the same syringes for different sample concentrations. After switching to clean syringes, the 60kDa sample was found to have M_w of 89kDa in relatively close agreement with expected value. All M_w were calculated using a differential refractive index increment (dn/dc) of 0.164 mL/g obtained from literature. Measured dn/dc averaged around 0.132 mL/g which produces higher molecular weights systematically.

Protein Purification Using an Elastin-like Polypeptide Tag

College of Sciences and Health Professions

Department of Chemical and Biochemical Engineering

Student Researchers: Ian Conant; Teisha Mullins

Faculty Advisor: Nolan B Holland, Ph.D.

Abstract

Elastin-like polypeptides (ELPs) reversibly aggregate and phase separate above a specific transition temperature and solubilize below it. They can be attached to recombinant target proteins as a tag to facilitate protein purification in a process called inverse transition cycling (ITC). ITC consists of alternating rounds of hot and cold centrifugation. ELPs are composed of repeats of the structural sequence of the elastin protein, Gly-Xaa-Gly-Val-Pro. Xaa is a "guest residue" in the sequence and can be replaced by any amino acid, with the exception of proline, in order to alter the temperature response. We present here use of Gly-Leu-Gly-Val-Pro for tagging and purifying a gadolinium binding protein domain. After the protein purification, it is ideal to remove the ELP tag from the target protein. To accomplish this, a tobacco etch virus (TEV) protease cut site was inserted between the target protein and the ELP tag. The TEV protease is also tagged and expressed with an ELP so that once the TEV protease cleaves the ELP tag from the target protein, a single round of thermal cycling can remove both the free ELP tag and the ELP-tagged TEV protease. The pure target protein is then left in the solution.

Development and Validation of Methods to Rate Components of a Balance Training Program

College of Sciences and Health Professions

Student Researcher: Natalie Helms

Faculty Advisors: Debbie Espy; Ann Reinthal, COSHP-Health Sciences

Abstract

Control one's center of mass and base of support are very important in preventing falls. These skills can be learned by older adults with balance training programs and video gaming is emerging as an effective balance training method. Self-rating of balance difficulty scales for use while playing these games has not been researched. The purpose of this study was to select games and create a self-rating scale for balance training. METHODS: In this pilot study, 5 Xbox 360 Kinect games were chosen and 5 participants played these games on varied surfaces. While playing the games, the participants rated their own balance on a scale that was created by the researchers. RESULTS: It would be necessary to expand the first 5 points of the scale to give a greater range. Most of the games that were chosen would be feasible in a clinical setting, but some changes would need to be made to the order of the games/surfaces to reduce the learning curve. CONCLUSION: It was clear that, although a few changes need to be made, the balance program and scale used would be feasible in a clinical setting and would give clinicians and clients a program that is easily progressive and modified while still being safe and effective.

Java Application for Filling in Missing Values in Motion Lab Data
College of Sciences and Health Professions

Student Researcher: Shane Poloha

Faculty Advisor: John Walsh, COSHP-Math

Abstract

Over the course of this summer, the Health Science Department needed an effective way of filling in gaps in data collected by its motion capture lab. Ultimately, the equipment used by this lab records the x, y, and z coordinates of a test subject at various points on the human body over a series of times. Because this data is recorded through the use of a system of cameras, certain parts of the body may be hidden at certain positions, thus leaving data unavailable at various times.

To solve this problem, a computer program was created that is able to fill in the missing data, return an output file with the filled in data, and provides and easy to use interface for users.

Predictors of Dropout in Adults Seeking Psychosocial Treatment Posttrauma

College of Sciences and Health Professions

Student Researcher: **Martha M. Golubski**[1]

Faculty Advisors: **Lisa Stines Doane, Ph.D.**[1]**; Dawn M. Johnson, Ph.D.**[2&3]**; Ed Waldrep, M.A.**[3]

Abstract

[1] ***Department of Psychology, Cleveland State University***
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Because posttraumatic stress disorder (PTSD) is a chronic disorder with serious physical and mental health outcomes, it is critical that adults who seek treatment posttrauma receive an adequate dose of psychosocial treatment. Unfortunately, the rate of premature dropout from PTSD treatment is very high (Tarrier et al., 2000) Those who drop out of treatment may vary on important characteristics from those who do not. The current study will compare treatment completers to those who have dropped out of treatment in a longitudinal study of PTSD treatment and treatment choice. It is important to understand whether any key variables may predict those who will drop out because such knowledge will allow us to develop better retention strategies and allow us to target certain symptoms or modifiable variables early in the treatment process (Bryant et al., 2007).

Determining the Effects of Efference Copy on Space Perception by Comparing Degree of Schytzotypal Traits and Accuracy of Distance Perception

College of Sciences and Health Professions

Student Researchers: Lucinda V. Rohde and Govind Sailesh Pappu

Faculty Advisor: Naohide Yamamoto

Abstract

Efference copy has been considered as a component of nonvisual space perception, but empirical data that support this notion have been sparse. The present study was designed to find evidence for the involvement of efference copy in space perception by capitalizing on the idea that dysfunctional efference copy underlies positive symptoms of schizophrenia. In two experiments, blindfolded participants who had varying degrees of premorbid schizophrenia (i.e., schizotypy) viewed a target and then either walked toward it without vision or verbally estimated its distance. It was hypothesized that high-schizotypal participants would be less accurate than low-schizotypal participants in the target-directed walking task, given that efference copies generated by walking presumably take a part in walked distance perception. By contrast, these two groups were predicted to perform similarly in the verbal distance estimate task because no intentional actions (and thus no efference copies) were involved in this task. Results showed that high- and low-schizotypal groups performed very similarly in both tasks, posing a question about the role of efference copy in space perception. Several possibilities were discussed to explain why schizotypal traits did not affect performance in the target-directed walking task.

Improving Fuel Usage in Microchannel Based Fuel Cells

College of Sciences and Health Professions

Physics Department

Student Researcher: Joseph D'Alessandro

Faculty Advisor: Petru S. Fodor

Abstract

In this work the fluid flow through a microchannel based fuel cell is modeled. The particular design employed exploits the laminar nature of the fluid flow at small Reynolds numbers to keep the fuel and oxidizer confined in the vicinity of the corresponding electrodes, without the need for a proton exchange membrane (PEM). The performance of these cells is evaluated as a function of the aspect ratio of the channel used and the flow rates through it. Based on the reactants' consumption rates, the best performing cells are the ones with high aspect ratio operated at high Péclet numbers. The formation of a depletion boundary layer close to the electrodes of the cell is found to be the main factor limiting the efficiency of this type of cells, and strategies based on using patterned surfaces are explored to improve mass transfer across this region.

Bead – Spring Model for Molecular Dynamics in a Creeping Flow

College of Sciences and Health Professions

Physics Department

Student Researcher: Prasenjit Bose

Faculty Advisors: Petru S. Fodor; Miron Kaufman

Abstract

In polymer physics, systems consisting of chains formed by spring connected beads are often used to understand the dynamics of linear polymers. In our project, we simulated the motion of such a chain advected by a fluid through a rectangular micro-channel. We considered the creeping laminar flow, i. e. zero Reynolds number. The differential equations of motion for each bead were solved numerically using 4^{th} order Runge-Kutta technique. The dynamics of this nonlinear mechanical system is studied as a function of model parameters: i.e. the spring equilibrium distance, the mass of a bead, the spring constant, and fluid initial velocity. Advanced techniques such as Lyapunov exponent calculation and fast Fourier transform are used to characterize the motion of the system.

Amplification and Electroporation of Plasmid EGFP-tba2 for Live Cell Imaging of the Primary Cilium in mCCD Cells

College of Sciences and Health Professions

Student Researcher: Andreea Sandu

Faculty Advisor: Andrew Resnick

Abstract

Primary cilia are nonmotile, solitary organelles that project from the surface of almost all vertebrate cells. These organelles are hypothesized to possess significant sensory functions and are associated with a variety of disorders including polycystic kidney disease, hypertension, obesity, and diabetes. Therefore, it is of great interest to observe how certain stimuli perceived by primary cilia effect cell behavior and physiology. The objective of this research is to apply a green fluorescence to the primary cilia of mCCD cells for easier viewing under a live cell imaging microscope.

Position Detection and Tracking for the Calibration of Optical Trap Stiffness

College of Sciences and Health Professions

Student Researcher: Joseph Glaser

Faculty Advisor: Andrew Resnick

Abstract

Optical traps have been in use in microbiological studies for the past 40 years to control particles on the micron scale. Given the need for a non-invasive method of mechanically stimulating the primary cilium of a Mouse Cortical Collecting Duct (MCCD) epithelial cell, an optical tweezers set-up was created in lab. The results of this summer's work include a particle tracking software, analysis of particle behavior under an optical trap, and physical characteristics of our trap.

Optimizing Cell Growth within a Flow Chamber

College of Sciences and Health Professions

Student Researcher: Josh Orzel

Faculty Advisor: Andrew Resnick

Abstract

Cells are what make up all life around us and yet we still do not know everything there is to know about them. By observing their reaction to their surroundings or stimuli, we can learn about cells and how they work. In my research, I need to find a condition for the cells which optimizes their growth. This includes making sure my environment is sterile, because cells have no immune system, as well as finding a protein that encourages the cells to grow on the filters. After a condition for cell growth is found, we can then grow the cells in the flow chamber and subject them to a flow. Then, we are able to observe the cells reaction, if any, and try to figure out what caused that reaction.

Novel Synthesis of Glyco-Protein Conjugate

College of Sciences and Health Professions

Department of Chemistry

Student Researcher: Valentinas Gruzdys

Faculty Advisor: Xue-Long Sun, Ph.D

Abstract

Development of protein-glycopolymer conjugates carries potential for the generation of therapeutic agents and biological probes. In this work, a novel synthesis of well-defined glycopolymer-protein conjugate based on isourea bond formation is presented. The crucial intermediate for its preparation is a well-defined cyanate chain-end functionalized glycopolymer presenting multiple copies of lactose epitope units, obtained *via* cyanoxyl-mediated free-radical polymerization in one-pot fashion. Bovine serum albumin (BSA) and lysozyme were employed as amine-containing model protein, and the resulting bioconjugates were characterized by SDS PAGE (sodium dodecyl sulfite polyacrylamide gel electrophoresis), phenol-sulfuric acid assay and ESI-MS (electron spray ionization mass spectroscopy). The versatility of the synthetic strategy presented in this work was the oriented multivalent carbohydrate modification of protein in straightforward approach and in aqueous mild conditions.

Prostate Cancer cell Specific Small RNAs Discovery by Deep-Sequencing

College of Sciences and Health Professions

Student Researcher: Fred Guzzo

Faculty Advisor: Girish C. Shukla

Abstract

INTRODUCTION and BACKGROUND: Prostate cancer (PCa) is the leading diagnosed and second leading cause of cancer related deaths in American men. According to year 2010 cancer projection statistics by American cancer society 217,730 men were diagnosed for prostate cancer, which accounts for 28% of all male cancers. Unfortunately, 32,015 men were predicted to die with metastatic PCa alone in the same year which makes PCa is second leading men killer in the United States (Jemal et al., 2010).

Male hormone **Dih**ydrotestosterone (DHT) is a requirement for the normal growth and differentiation of male phenotype. Coincidently, PCa cancer growth is also highly dependent on DHT. In normal male development, DHT activates it cognate receptor protein known as androgen receptor (AR). Normally, AR resides in the cytoplasm of epithelial cell, however after binding to DHT, it translocate to nucleus of cell. In the nucleus, AR binds to >600 known protein coding genes' promoter and activates a massive transcriptional program which drives the proliferation of cell, which is necessary for normal growth and development of cell. However, in cancer the due to various cellular signaling AR driven "proliferation shut-off" does not takes place. (Dehm and Tindall, 2007). In addition, to protein coding gene, it has been suggested that AR also has potential to transactivte the transcription of noncoding regulatory RNA molecules, including small microRNAs (miRNA) (ref).

Initial stage of PCa is male hormone-dependent and is treated by chemical and surgical castration (ref). However, further accumulation of genetic and environmental alterations transform the cancer into an aggressive and therapy resistant prostate cancer known as hormonal-refractory cancer. The cellular and molecular mechanisms which promote the therapy resistant cancer are not clear.

The Effects of Daily Light Duration on *Scenedesmus dimorphus*

Fenn College of Engineering

Student Researcher: Grace Miller

Faculty Advisor: Joanne Belovich

Abstract

Algae are aquatic, single-celled photosynthetic eukaryotes, and some species have shown potential to be a source of biofuel. Some algal species have been utilized in the production of lipids, which may then be refined to replace or compliment non-renewable petroleum. *Scenedesmus dimorphus* has been shown to be easily cultivated and produces a high return of lipids.

The cultivation of *S. dimorphus* requires light, carbon dioxide and other nutrients. There have been extensive studies on varying these parameters in order to efficiently increase algal growth and consequently, maximize lipid production. There have been numerous daylength-related studies on other lipid-producing algal species, although the optimum daylength for *S. dimorphus* has yet to be fully ascertained.

Photosynthetic organisms receive the energy to create the energy-storage compounds of the cell through light. Photoautotrophs have a broad tolerance to extreme light-cycles. However, most organisms exhibit a middling effect: too little or too great of an exposure to light may be detrimental to a cell.

To prevent photoinhibition, which is a decrease in photosynthesis due to extensive light exposure, most algal cultures are grown with light cycles that include a period of darkness. This allows the cell to complex destructive free-radicals caused by UV radiation. Some species tolerate the effects of free-radical photoinhibition better than others. The purpose of this experiment is to determine the threshold tolerance of *S. dimorphus* to extreme instances of light. Two daylengths will be tested, continuous light (24:0) and intermittent light (16:8). The growth rates, cellular concentration, pH, and final lipid contents will be measured and compared amongst the two light cycles.

CHARACTERIZATION AND MODELING OF THIN FILM DEPOSITION PROCESSES

Fenn College of Engineering

Department of Chemical and Biomedical Engineering

Student Researcher: Charles F. Tillie

Faculty Advisor: Dr. Jorge E. Gatica

Abstract

With the raise of environmental awareness and the renewed importance of environmentally friendly processes, surface pre-treatment processes based on chromates have been targeted for elimination by the United States Environmental Protection Agency (EPA). Indeed, chromate-based processes are subject to regulations under the Clean Water Act and other environmental initiatives, and there is today a marked movement to phase these processes out in the near future. Therefore, there is a clear need in developing new approaches in coating technology aimed to provide alternative practical options to chromate-based coatings in order to meet EPA mandates. This research focuses on calorimetric analysis and mathematical modeling to develop an alternative process.

Assessment of Sugar Cane Bio-ethanol Dehydration Process Alternatives

Fenn College of Engineering

Department of Chemical and Biomedical Engineering

Student Researcher: Michel Kahwaji Janho

Faculty Advisor: Dr. Jorge E. Gatica

Abstract

Environmental effects and health hazards posed by fossil-fuel based technologies complemented by changes in the global economy have further demanded the need for developing "cleaner" and more efficient technologies that rely on renewable or synthetic resources. An alternative, commonly referred to as bio-fuels, has significantly matured and today's economy recognizes the significance of being able to produce ethanol from renewable resources such as biomass. Moreover, the potential of ethanol to be further converted to hydrogen makes it a very attractive alternative to replace or complement fossil fuels as sources of energy.

Though many techniques for ethanol dehydration are known; adsorption, distillation, hybrid processes, and pervaporation, are the most common technologies in practice. Two alternatives ethanol dehydration technologies are considered in this work. The first is based on the combination of distillation and azeotropic distillation, while the second relies on hybrid distillation and pervaporation processes. Both alternatives are simulated and their optimal design and operating parameters are identified by means rigorous simulation (Aspen Plus).

Mathematical Modeling of a Gravity Settler for Algae Harvesting

Fenn College of Engineering

Department of Chemical and Biomedical Engineering

Student Researchers: Karl K. Scott; Scott A. Hug

Faculty Advisor: Dr. Jorge E. Gatica

Abstract

Biodiesel is one of the fastest growing alternative fuels in the U.S. It can be used in existing diesel equipment and vehicles, and can use the existing distribution infrastructure. As a renewable resource, it can reduce our carbon dioxide output and it has an energy ratio that is significantly (300%) more favorable than corn ethanol. Existing biodiesel plants rely on sources such as recycled grease, meat fat, and soybean or canola oil, with the latter two most useful for large-scale commercial facilities. However, canola and soybean compete with food crops, and cannot meet the long-term demand for transportation fuel.

This project presents preliminary Computer-aided Design (CAD) and Computational Fluid Dynamics (CFD) analysis of a gravity settler operating in our laboratories (cf. Figure 1) for concentration of algae produced in a semi-batch system. The modeling environment used was COMSOL Multi-Physics, a robust and versatile environment for equation-based modeling. COMSOL Multi-Physics, also referred to as FEMLAB, is a finite-element based modeling (FEM) environment, which can be efficiently linked with commercial CAD packages. Preliminary results demonstrating inter-linking COMSOL modeling environment with a modern CAD package, SolidWorks™, are also presented.

Dendritic Array Growth During Directional Solidification: With and Without Natural Convection

Fenn College of Engineering

Department of Chemical and Biomedical Engineering

Student Researcher: Arianna A. Romano

Faculty Advisor: Dr. Surendra Tewari

Abstract

Dendritic microstructures resulting from solidification (metal casting) determine the mechanical properties and useful life of many engineering components that are fabricated by this technology. During terrestrial solidification gravity induced convection in the melt ahead of the solidifying interface produces detrimental chemical and structural in-homogeneities. Convection is greatly reduced in space. Main purpose of these experiments is to grow Al-7% Si alloy single dendritic crystals in space in the absence of convection, and compare them with those solidified on earth. The experiments are expected to provide valuable data for verification of theoretical solidification models, and also to help improve the terrestrial solidification processing technologies.

Two samples (MICAST6 and MICAST7) were directionally solidified on the International Space Station under a joint research program between NASA and European Space Agency (ESA). Preliminary results from MICAST6 (Space grown) and MICAST6G (Terrestrial equivalent grown at CSU) show that space solidified sample has more homogeneous microstructure than terrestrially grown sample. It also appears that natural convection reduces the primary dendrite-nearest neighbor spacing, and increases the dendrite-trunk diameter. Primary dendrites having a range of shape and spacing are stable in an array solidifying under unique steady-state processing conditions, even during convection free directional solidification in space.

Comparison of Cell Adhesion on Different Metal Surfaces

Fenn College of Engineering

Student Researcher: Rebecca Jensen

Faculty Advisor: Dr. Joanne Belovich

Abstract

In search for the optimal design of cell adhesion in vivo, it is necessary to study many different surfaces. A variety of materials have been named as proper surfaces used during implantation within in the body. Surfaces include metals such as stainless steel, zirconium, tantalum, and titanium. For optimum results, a comparison must be conducted to determine what metal surfaces provides the best surface attachment qualities, in addition to best proliferation qualities. These qualities are evaluated for each metal surface and then compared against one another. This data will prove which metal is the most biocompatible, providing the best possible surface for cells to grow and attach within the body.

Detection of Electrocardiogram (ECG) Signals with Noise Artifacts

Fenn College of Engineering

Department of Electrical and Computer Engineering

Student Researchers: Berney Montavon; Andrei Bialevich; Mehmet Ergezer

Faculty Advisor: Dan Simon

Abstract

Myocardial infarction (MI) occurs when the heart muscle dies, or becomes permanently damaged, due to blockage of the blood vessels that supply oxygen to the heart. MI can be induced by physical exertion and is identified as the leading cause of death among firefighters. Using innovative non-contact, non-gel-based sensors composed of carbon nanotube arrays, electrocardiogram (ECG) signals can be detected non-invasively, and can then be used as an early indicator of cardiac irregularities. However, ECG signals are often corrupted with noise due to muscle movement, electrode motion, and respiration. We therefore implemented a normalized least mean square (NLMS) algorithm using inputs from our ECG sensors and a three-axis accelerometer.

After a noise-free ECG signal is obtained, we automatically detect the number of heartbeats in the signal. This is accomplished by isolating the QRS complex of the ECG signal through filtering, differentiating, squaring, and averaging. Threshold logic is then applied to detect the ECG peaks. Our code provides 99.98% accuracy when applied to the MIT-BIH arrhythmia database by correctly counting 4459 out of 4460 beats from two randomly chosen ECG data files.

Participatory Sensing for Intelligent Transportation Systems

Fenn College of Engineering

Student Researchers: Arnold Csok; Steven Reba

Faculty Advisors: Wenbing Zhao; N. Sridhar; C. Yu; P. Chu; Y. Fu; Y. Zhu

Abstract

In this project, we investigated the feasibility of doing participatory sensing to facilitate traffic data collection in a large scale and to improve driver safety. Smart phones are equipped with a number of sensors, the most important of which is the GPS. In this research, we found out that the GPS in the Android devices is fairly accurate and it gives very good trajectory information. We attempted to further improve the accuracy by fusing other sensor data (namely, accelerometer and gyroscope), and by refining the GPS data using the velocity and bearing data. It is discovered that the accelerometer and gyro data are too noisy to use, and the refining method we designed yield no noticeable improvement. During this project, the students obtained valuable skills and experiences in application development for the Android and iOS platforms.

Population Trends on Cleveland's West Side: Change and Consequences

Levin College of Urban Affairs

Student Researchers: Kim Lyons; Anh Trinh

Faculty Advisors: Dr. Mittie Davis Jones; Dr. Mark Salling

Abstract

Census Bureau data for 2010 indicate that Cleveland continued to lose population as it has since 1960. This project explored how population change was occurring on the city's west side and the impact of those changes. West side neighborhoods lost fewer residents than the east side and some eastsiders are moving westward, particularly African-Americans. Overall the neighborhoods have become more diverse with larger percentages of Latinos and Blacks. The rates of poverty and persons receiving Medicaid and food stamps also grew as did the percentage of homeowners and renters.

Generally, persons who recently moved from the east side of the city to the west side reported an improvement in their quality of life. They highlighted such benefits as recreational opportunities and safety. Conversely, longer term residents of the west side were less optimistic about the area – citing a decline in services in recent years and planned or actual public school closings. Among the positive changes mentioned among residents were the improvements in the Gordon Square Arcade area and the Steelyard Commons retail development.

Service providers involved in this project seem less affected by the neighborhood population change than the loss of resources because they serve the entire city and/or county. More significant for them is the loss or potential loss of funding that has led several agencies to consider or undertake merger, consolidation, or other types of partnerships.

The Housing Crisis in Euclid, OH: Analysis and Outlook

Levin College of Urban Affairs

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Abstract

Since the beginning of 2006, Euclid, an inner-ring suburb of Cleveland, has suffered from a high level of foreclosures and a decline in the single family housing market. The severity and pervasiveness of that decline is important to determine. A widespread and deep decline is likely to erode homeowners' confidence in the market, discourage investment and reinvestment and encourage moves out of the city. If instead decline is limited, either in severity or geography, it could lend both to market stability and to specific target areas for local public policy and investment.

In our analysis of six years of sales transaction data, we distinguish between the arms-length and distressed housing markets throughout the city's neighborhoods. We find that (1) in every neighborhood of the city the distressed market is too large, but that (2) in most neighborhoods the arms-length market, although smaller than optimal, has retained a reasonable measure of value, far more than the "typical" distressed sale.

Our analysis of the city's foreclosure activity uncovered two alarming findings. First, of foreclosed properties that re-sold, only 58% went to homeowners. Second, those homeowner purchases typically took more than 1.5 years to complete.

A Multi-Level Analysis of Green Business Practices: Impacting the Bottom Line through Strategic Human Resources (HR) Practices

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Abstract

There is an increasing emphasis and understanding of the value of environmental sustainability practices and how they affect the success of businesses. Sustainability practices help to cut costs and reduce the impact businesses have on the environment and the community. Businesses must analyze their impact on the ecosystem: everything that surrounds them; the supply chain, workers, materials, government, and the community in which it sits. Successful businesses build sustainability into their strategy, affecting everyone from top management to the line-workers. As the importance of these connections becomes more apparent, so does the lack of research connecting these topics to human resources and organizational behavior. Human resource topics that should be considered are: employee retention, satisfaction, organizational citizenship behaviors, safety and wellness. As such, several academic journals have put out calls for papers regarding sustainability. Our research begins to address this gap in the literature by providing a background review of research to date (including 63 articles), qualitatively exploring the construct of sustainability with interviews of 16 thought leaders, exploring what it means to organizations to be sustainable, and proposes a framework for future research.