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2015 UNDERGRADUATE RESEARCH POSTER SESSION

Abstracts

STUDENT CENTER ATRIUM
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10 AM - 2PM

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2015 Undergraduate Summer Research Award Poster Session

Poster Number	Title of Poster
College of Education and Human Services	
1	Fun versus Practical: Physiological Responses and Preference of Exercise Equipment
College of Liberal Arts and Social Sciences	
2	Archaeological Investigations in the Cuyahoga Valley National Park: Highlights of the 2015 CSU FieldSchool
3	Hungarian Heritage Speakers in the Greater Cleveland Area
4	History Speaks: Using Oral History to Teach Historical Thinking
5	Digital Archiving of the Dance Artist's Creative Process and Vision
College of Sciences and Health Professions	
6	Regulation of Meiotic Sister Chromatid Cohesion by ECO-1 and WAPL-1
7	Characterization of the detailed interaction interface between T. brucei telomere proteins TRF and TIF2
8	Novel regulation of the pro-apoptotic protein PUMA in response to hypoxia
9	Assaying the Splicing Activity of Novel Human Disease Variants of U4atac snRNA
10	Dual Stimuli Response Frequency and Stimulus Choice of the African Clawed Frog, Xenopus laevis, when presented with two stimuli
11	Stormwater Management and Residents Perceptions
12	Invasive Species Facilitation in Bioswales and Rain Gardens in Greater Cleveland
13	Distribution of Sphaeriid Clams in Lake Erie Twenty-five Years After Invasion of Dreissena
14	Investigating Rhoptry Gene Conservation between Plasmodium yoelii and Plasmodium falciparum using the Polymerase Chain Reaction for DNA Amplification
15	Control of Meiotic Cell Divisions in Presence of Unrepaired chromosome breaks
16	Role in Recombination of Genes That Control Meiotic Cell Divisions
17	TMCO1 mediates cancer cell migration through regulating microtubule assembling
18	Lead optimization of tubulin inhibitor for cancer treatment
19	Optimizing the design and potency of diterpenic acid derivatives to improve cell membrane permeability and Hsp27 targeting characteristics
20	Mechanism of action by which 5-NIdR acts as a therapeutic agent against brain cancer
21	Nitrosylation of S100A8/ A9 protein complex by inducible Nitric Oxide Synthase
22	Cell Surface Sialylation Status of Monocytes and Macrophages
23	Development of a GC-MS Method for Investigation Mouse Plasma Amino Acid Levels and their Significance to the Circadian Clock
24	Can we increase the intensity of pro-active balance exercises?
25	Balance training application of a systematic framework for clinical decision making in therapeutic gaming for older adults
26	Safe Movement Practices by STNAs for Residents in Nursing Homes
27	Acoustic Objective and Subjective Measurements of Noise Levels in Various Places of Worship and the Potential Consequences on the Auditory System
28	Statistical Analysis of DASI Questionnaire and Modeling the Prediction of Heart Failure Risk in Patients
29	Dynamics of an optically trapped particle
30	Ciliary Mechanosensation in MDCK cells

31	Developing affordable wet-sample electron microscopy integrated with a temperature controlled sample holder
32	Synthesis of optimal polymeric microgels and their characterization with light scattering
33	Deducing Shape of Anisotropic Particles in Solution from Light Scattering: Spindles and Nanorods
34	Case Transition Format and Lexical Decision Performance: Does Spacing Reduce the Benefit of Orthographic Regularity?
35	Preliminary Investigation of the Role of Open Bigrams in Word Perception: Is There a Benefit to Having Flankers That Consist of Letters in the Word?
36	The effect of depression symptoms on the cardiac autonomic response to positive mood induction
37	Autonomic Nervous System response to interpersonal exclusion in Borderline Personality Disorder
38	Cultural Differences in Coping and Depression between Individuals of Middle-Eastern and Non-Arab Backgrounds
39	Enhancement of Solar Energy Conversion in Bio-derived Cells via Side Selective Modification of Photosystem I
40	Designing Tuftsin Conjugate for Directing Antimicrobial Ionophores to Macrophages

College of Sciences and Health Professions and Washkewicz College of Engineering	
41	Feasibility and Effects of Accelerometer Based Feedback on Paretic Upper Extremity Amount of Use in the Home Setting in Subjects Chronic Post-Stroke
42	Effects of Accelerometer Based Feedback on Clinical Measures and Paretic Upper Extremity Amount of Use in Subjects Chronic Post-Stroke
43	Effect of Accelerometer Based Feedback on Paretic Upper Extremity Amount of Use and Quality of Movement: A Case Study

Maxine Goodman Levin College of Urban Affairs	
44	The Profitability of Plagiarism: A Look at University Plagiarism Policies Across the Country

Washkewicz College of Engineering	
45	Processing Conditions for Ultrastable Surfactant-Free Nanoparticle Stabilized Foams
46	The Catalytic Gasification of Waste Polymers: Determining the Kinetics of the Sabatier Reaction
47	Experimental Analysis of Catalytic Gasification of Polyethylene
48	Creating miniaturized tissue constructs on a micropillar/microwell chip via 3D bioprinting technology
49	Tuning the Size of Elastin-like Polypeptide Nanoparticles
50	Characterizing Stimuli-Responsive Materials for Drug Delivery: Interactions with Model Compounds and pH Responsive Behavior
51	Effect of Solidification through Cross-Section Change on Dendritic Array in Single Crystal Castings
52	Community perceptions on substance abuse by underage
53	Laboratory and Field Testing of High Performance Repair Materials
54	Learning to Drive a Simulator: Impact of Prolonged Practice
55	Power Electronics Design for a Transfemoral Prosthesis
56	Robotics Training: Fundamentals of Robot Assembly and Programming
57	Computer Vision and Route Planning for Humanoid Robots
58	Parallel Selection Algorithms on GPUs: Implementation and Performance Comparison
59	Integrating an Android Device into Embedded Computer Systems
60	Prosthetic Socket Surface Initialization – For Future Use in Subject-Specific Socket Optimization
61	Characterization of Rotor Aerodynamics of the Laboratory-scale Miniature Wind Turbines
62	Ultra-high resolution simulations of the atmospheric boundary layer across the shores of Lake Erie
63	Privacy-Aware Computer-Vision Based Human Motion Tracking
64	Selective Plane Illumination Microscopy

Fun versus Practical: Physiological Responses and Preference of Exercise Equipment

College of Education and Human Services

Student Researchers: David Ryland, Alanna Shamrock, and Shana Strunk

Faculty Advisors: Kenneth Sparks and Eddie T.C. Lam

Abstract

Until the invention of the rowing machine, rowing was only attainable on water. The Champiot Ultra Rowing Bike allows athletes to row on land and remains mobile.

PURPOSE: The purpose of this study is to determine whether the Rowing Bike is more efficient and enjoyable than a traditional rowing machine.

METHODS: Energy expenditure, heart rate, and rate perceived exertion (Borg Scale) were evaluated on 20 males (aged 23.75 ± 2.613) and 20 females' (23.05 ± 3.605) while riding the rowing bike and the traditional rowing machine for 20 minutes at 75 percent of their age-predicted maximal heart rates. Post-testing, subjects completed a preference survey. A mixed-design ANOVA in SPSS version 18.00 analyzed and compared all physiological responses and gender differences.

RESULTS: Significant differences ($p<0.01$) were found for energy expenditure, VE and RPE ($p<0.05$) on the different machines. Significant differences were also found when comparing the physiological responses of genders. The questionnaire showed significantly that people prefer the Rowing Bike.

CONCLUSION: The data collected indicated that the subjects prefer the row bike; however the rowing machine provides a more quality workout.

Archaeological Investigations in the Cuyahoga Valley National Park: Highlights of the 2015 CSU FieldSchool

College of Liberal Arts and Social Sciences

Student Researcher: Dave Goodwater

Faculty Advisor: Phil Wanyerka

Abstract

Since 2008, CSU's Department of Anthropology has been conducting an annual summer archaeological fieldschool in the Cuyahoga Valley National Park. As our excavations have become more extensive and more complex, there's been a real need to chronicle and produce a high-quality professional documentary of our summer's field research. Not only is this video going to be showcased in our annual Ohio Archaeology Symposium in October, but we also will be using portions of this video for both visual instruction in the classroom and for public outreach. We often say that "a picture is worth a thousand words" but a video is worth so much more for it brings to life the essence of what one cannot see by simply reading a book or looking at lone photos. This year's fieldschool focused on a Middle Woodland (100 BC- AD 400) prehistoric village site (33SU608) located within Boston Township. Our work at the site was guided and enhanced by the use of geophysics, namely a fluxgate gradiometer, which allowed us to look for and identify various prehistoric features or anomalies lying below the ground surface. As a result of our work at 33SU608 we were able to locate and excavate several prehistoric features including a midden (garbage pit), a storage pit, and a fire hearth that contained elite diagnostic pottery. This season's work was part of a larger series of initiatives that seeks to institutionalize and engage student involvement in faculty research here at CSU.

Hungarian Heritage Speakers in the Greater Cleveland Area

College of Liberal Arts and Social Sciences

Student Researchers: Kaela Bierce, Viladate Chaialee, Alexandra Coates, and Rachel Daley

Faculty Advisor: Lydia Grebenyova

Abstract

The present study focuses on the language speakers whose first language has been degraded by continuous exposure to a new, dominant language. The specific goal is to ascertain the cultural elements of the Cleveland Hungarian community and how this culture impacts language ability of the heritage Hungarian speakers. We reveal language preservation processes and the effect of living in a country with a different dominant language, in this case English, on the minority heritage language. We constructed a survey of cultural and linguistic items that include the participants' connection to the community, how they use and practice Hungarian, and linguistic items relating to pronunciation, word order, null subjects, and 'focus' which are all areas especially prone to English influence. We conducted interviews with members of the Cleveland Hungarian community that range from original immigrants to third generation speakers. Our findings revealed that the vibrant heritage culture relating to the Hungarian language, history and traditions, practiced through such outlets as the long-standing scouts program, has allowed the Hungarian language to be preserved after several generations in the United States. Our study also revealed that English has influenced the heritage Hungarian in all categories tested.

History Speaks: Using Oral History to Teach Historical Thinking

College of Liberal Arts and Social Sciences

Student Researchers: Victoria McDonough and Christopher Morris

Faculty Advisors: Shelley Rose and J. Mark Souther

Abstract

This research project sought to enhance the viability and usefulness of existing oral history interviews in a classroom setting and to develop best practices and resources for teachers to use in lesson planning. We sampled a collection of oral history interviews from the Cleveland Regional Oral History Collection according to a list of search terms pertaining to content standards typically taught in a high school classroom. After listening to these interviews, we created shorter segments called story clips which highlighted a particular event, topic, or concept.

The essays and lesson plans published on the Social Studies @ CSU blog (www.socialstudies.clevelandhistory.org) explore oral history pedagogy and how to successfully deploy oral history interviews in the classroom. The existing scholarship on oral history pedagogy dealt with creating oral history by having students conduct interviews of people within their communities. This blog series serves as a primer on how to utilize existing oral histories and story clips in the classroom. We discuss how they can be used to introduce subject matter, develop historical thinking skills, and cultivate personal connections with history.

We researched how to tie those story clips to Ohio Department of Education Social Studies curriculum standards. We then paired these clips with content standards, abstracts, and keywords on the History Speaks website (www.historyspeaks.clevelandhistory.org). This website serves as a resource for teachers and provides examples as to how to tie story clips to state education standards.

Digital Archiving of the Dance Artist's Creative Process and Vision

College of Liberal Arts and Social Sciences

Student Researchers: Rafeeq Roberts and Danielle Davis

Faculty Advisor: Lynn Deering

Abstract

Cleveland has a rich history in the development of modern dance. Because dance is mainly experienced in the here and now, the collective knowledge and artistic skills of many dance artists are mostly shared with viewers of their live performances or those who they mentor. This project uses video documentation to explore the approaches and insights of a choreographer and dancers in the creative process. The resulting piece of videography will inform the design of a future digital archive of many dance artists associated with CSU and the greater dance community.

Videographers Rafeeq Roberts and Danielle Davis filmed Amy Miller, Associate Artistic Director of Gibney Dance, NY and former Northeast Ohioan during the CSU Summer Dance Workshop as she taught technique and creative process, and choreographed a dance for CSU dance students. The four dancers collaborated with her in the creation of the work. Providing a varied perspective on the creative process, three other influential dance artists with connections to Northeast Ohio were also recorded sharing their experiences in teaching, rehearsing, and performing.

The final digital work is a creative product that serves as an aesthetic and informational resource. Through its creation, insight for developing a future digital archive preserving many dance artists' visions has been initiated.

Regulation of Meiotic Sister Chromatid Cohesion by ECO-1 and WAPL-1

College of Sciences and Health Professions

Student Researcher: Kyle T. Schroeder

Faculty Advisor: Aaron F. Severson

Abstract

Cohesin is a widely conserved, tetrameric protein complex that tethers replicated sister chromatids during meiosis and mitosis. Two cohesin subunits, SMC-1 and SMC-3, and a third subunit, the α-kleisin, form a ring proposed to encircle sister chromatids. Different kleisins associate with cohesin during mitosis and meiosis. SCC-1 is the mitotic kleisin. Meiotic cohesin can associate with either REC-8 or COH-3/4. REC-8 and COH-3/4 cohesins differ greatly in their functional properties, indicating that the kleisin determines meiotic cohesin function. Early in meiosis, REC-8 and COH-3/4 cohesins are triggered to become cohesive at different times and by different mechanisms. Later in meiosis, REC-8 and COH-3/4 cohesins are removed from chromosomes at different times and places and by different mechanisms. Studies of sister chromatid cohesion (SCC) establishment and release by SCC-1 cohesin in mitotically proliferating yeast and vertebrate cells showed that a protein called WAPL can open the cohesin ring, allowing cohesin to dissociate from chromosomes and preventing SCC establishment. The Eco1 acetyltransferase establishes SCC by acetylating Smc3, which prevents WAPL binding. In mitotic prophase, WAPL again promotes cohesin removal. The aim of our study is to determine whether ECO-1 and WAPL-1 function similarly to regulate the two functionally specialized meiotic cohesin complexes.

Characterization of the detailed interaction interface between T. brucei telomere proteins TRF and TIF2

College of Sciences and Health Professions

Student Researchers: Jennifer Kungle, John Sabljic, and Tia Nikova

Faculty Advisor: Bibo Li

Abstract

The protozoan parasite *Trypanosoma brucei* causes fatal African trypanosomiasis in humans and nagana in cattle. *T. brucei* switches its variant surface glycoproteins (VSGs) inside the mammalian host, evading the host immune response. VSGs are expressed monoallelically from subtelomeric expression sites, and telomere proteins regulate VSGs.

We previously found that telomere protein *Tb*TIF2 interacts with *Tb*TRF (TTAGGG-repeat binding factor) and plays important roles in VSG switching regulation. *Tb*TRF maintains the telomere terminal structure. *Tb*TIF2 is essential for subtelomeric integrity and suppresses VSG switching by inhibiting subtelomeric gene conversion. Depletion of *Tb*TIF2 decreases *Tb*TRF protein level. We hypothesize that *Tb*TRF-*Tb*TIF2 interaction is essential for maintaining *Tb*TRF protein level. We test this hypothesis by mapping the interaction between *Tb*TRF and*Tb*TIF2. *Tb*TRF has both N-terminal TRF Homology (TRFH) and C-terminal Myb domains. *Tb*TRFH contains seven helices and interacts with the N-terminus of *Tb*TIF2 (aa 2-190). We found that deleting either of the first two helices in *Tb*TRFH abolishes its interaction with *Tb*TIF2. Currently we are generating deletion and point mutations within the first two helices of *Tb*TRFH, which will be tested for their ability to interact with *Tb*TIF2 to determine the key residues in *Tb*TRFH that are required for interacting with TbTIF2.

**Partially Supported by the McNair Scholars Program*

Novel regulation of the pro-apoptotic protein PUMA in response to hypoxia

College of Sciences and Health Professions

Student Researchers: Mareem Ali and Brianna Boslett

Faculty Advisor: Crystal M. Weyman

Abstract

Ischemic injury in skeletal muscle caused by hypoxic (low oxygen) conditions occurs in response to vascular and musculoskeletal traumas, diseases and following reconstructive surgeries. Hypoxia induces apoptotic cell death. We have reported that the protein PUMA plays a critical role in the apoptosis of myoblasts in response to culture in differentiation media as well as exposure to DNA damaging chemotherapeutic agents. We have also determined that the transcription factor MyoD, known to control the differentiation process, also plays a role in these apoptotic processes by directly increasing the expression of PUMA mRNA. Herein, we report an increase in PUMA protein and mRNA in response to hypoxic conditions. Specifically, treatment with cobalt chloride to activate hypoxia-inducible factor 1-alpha (HIF-1A), the transcription factor regulating the response to hypoxia, resulted in nearly a six-fold increase in PUMA mRNA after 3 hours. After six hours of treatment, the elevated level of mRNA was only 2 fold that detected in untreated myoblasts. This elevated level of mRNA resulted in a three-fold increase in PUMA protein after 3 hours that returned almost to untreated levels after 6 hours. Future experiments will focus on determining if MyoD contributes to this increase in PUMA expression.

Assaying the Splicing Activity of Novel Human Disease Variants of U4atac snRNA

College of Sciences and Health Professions

Student Researchers: Maitri K. Patel and Rosemary C. Dietrich

Faculty Advisors: Richard A. Padgett and Girish Shukla

Abstract

In eukaryotes, pre-messenger RNA (pre-mRNA) splicing is an essential process in gene expression. Splicing is carried out by a dynamic multi-megadalton RNA-protein complex known as the spliceosome. Sequential transesterification reactions catalyzed by the spliceosome convert pre-mRNA to mRNA by removing the intervening sequences (introns) and joining the coding sequences (exons) together. Small nuclear RNAs (snRNAs) are essential splicing factors. Biallelic mutations of the human *RNU4ATAC* gene, which codes for U4atac snRNA, have been identified in patients diagnosed with Microcephalic Osteodysplastic Primordial Dwarfism type I (MOPD I). MOPD I is an autosomal recessive disorder characterized by extreme intrauterine growth retardation, multiple organ abnormalities, and typically early death. The mutations that have been studied biochemically reduce U4atac snRNA function and impair minor class (U12-dependent) intron splicing. Four novel patient mutations, 37 G>A, 46 G>A, 48 G>A and 118 T>C, have recently been discovered. To evaluate the functional effects of these newly discovered mutations on U12-dependent splicing, we incorporated each of these mutations into a modified human *RNU4ATAC* gene construct by site directed mutagenesis. Following verification of the mutations by DNA sequencing, we prepared DNA for use in an *in vivo* splicing assay that is based on genetic suppression. These mutations are expected to affect the binding of proteins to U4atac snRNA that are important in formation of the catalytically active form of the spliceosome. We do not yet know how the consequent defective U12-dependent splicing affects gene expression and yields the MOPD I disease pathologies, but this study allows us to better understand the mechanistic basis of MOPD I and will serve as an important foundation for further studies and possible therapeutic intervention in the future.

**Supported by the McNair Scholars Program*

Dual Stimuli Response Frequency and Stimulus Choice of the African Clawed Frog, Xenopus laevis, when presented with two stimuli

College of Sciences and Health Professions

Student Researchers: Mingo Rolince, Heidi Pignolet, and Alexa Hoy

Faculty Advisor: Jeffrey Dean

Abstract

This preliminary study examines responses of African Clawed Frogs to simultaneous presentation of two stimuli. Frogs were tested in a round arena with water 4 cm deep. Four stimulus rods driven via computer-controlled stepper motors were concealed in a screen suspended above the water. These rods could present a lateral line stimulus, a visual stimulus, or a combination of both. Overall, reactions and no reactions were evenly distributed--51.1% and 48.9%, respectively. Frogs responded more frequently to rostral than caudal stimuli (chi-squared 20.8, df=11, $p<0.04$). Frogs reacted more to stimuli between -90° and 90°. Turn angle depended linearly on stimulus angle (e.g., Turn angle = 0.44 + 0.64 x Stimulus angle; $p_{slope} < 0.0001$; $R^2_{adj} = 69.5\%$). (The distributions of stimulus angles appear slightly skewed as often the same stimulus rod was retested after the frog responded and partially oriented towards it, prompting a second test with smaller angles.) Two stimuli did not elicit more responses than one stimuli (P=0.25). The frogs' choice of stimulus depended primarily on stimulus proximity and angle, not stimulus type. When presented with two stimuli, the frog chose the nearer stimulus and the more rostral stimulus ($p < 0.0001$). The largest factor in predicting the frog's choice of stimuli seems to be the linear distance from the stimuli to the frog.

Stormwater Management and Residents Perceptions

College of Sciences and Health Professions

Student Researcher: Mark Gatesman

Faculty Advisor: Julie A. Wolin

Abstract

Stormwater runoff is a major problem in many residential municipalities. Rain water washes pollutants and chemicals off of streets, driveways and lawns. Stormwater management practices help filter out harmful particles before they enter into our water ways. The goal of this project was to assess green infrastructure stormwater practices throughout Cuyahoga County. We assessed 165 sites in over 10 cities in Cuyahoga County. We examined bioswales, bioretention basins, and rain gardens. Sites were visited in late May through early June and revisited in mid-July to early August. We compared spring condition of plants and gardens and recorded resident's perceptions whether positive or negative. We found residents are often unfamiliar with the purpose of rain gardens and bioswales, and why certain plants were planted. Improper care and maintenance results in loss of beneficial plants and provides an avenue for invasive species. Aesthetics are also issue for some residents who view them as weedy and unkempt. We created a project survey to study resident perception of stormwater management. One positive finding was that many cities, companies, and institutions are using green infrastructure in stormwater management. These practices can work if properly maintained, however resident input and education is important for local acceptance.

Invasive Species Facilitation in Bioswales and Rain Gardens in Greater Cleveland

College of Sciences and Health Professions

Student Researcher: Brittany Dalton

Faculty Advisor: Julie A. Wolin

Abstract

Stormwater management features such as bioretention systems and rain gardens provide valuable ecosystem services. They are ecologically engineered to counteract surrounding urban land use practices. However, new stormwater management features may also create an environment for invasive plant species. Invasive plants can affect ecosystem services, and have devastating economic impacts. This study was conducted to determine connections between surrounding land use and maintenance practices in stormwater management features throughout Greater Cleveland and the presence of invasive plant species. Initial site visits were conducted for 164 bioretention systems and rain gardens in Greater Cleveland. They were analyzed for physical characteristics, surrounding land use, and overall function, including level of erosion and exposed soils. An initial survey recorded all plants present, including invasive species, and a later revisit was made to each site to obtain a final plant survey. We predict a correlation between invasive species presence and increased impervious surface and surrounding land use heavily dominated by human activities, as well as poor maintenance practices. The presence of invasive plant species is also predicted to impact the ability of the stormwater management system to function properly and provide the valuable ecosystem services as originally intended.

Distribution of Sphaeriid Clams in Lake Erie Twenty-five Years After Invasion of Dreissena

College of Sciences and Health Professions

Student Researcher: Michael Keller

Faculty Advisor: Robert Krebs

Abstract

Clams in the family Sphaeriidae are widespread native mollusk species that are often overlooked. The distribution of these organisms in Lake Erie has not been examined in the 25 years since the initial invasion of the zebra mussel, Dreissena polymorpha. Carr and Hiltunen identified 10 species of Sphaeriidae in Western Lake Erie in 1961, of which Pisidium casertanum, P. compressum, P. nitidum, Sphaerium corneum, and S. striatinum and Musculium transversum, contributed 89.7% of all fingernail and pea clams sampled and were considered common. Four other species were reported as rare. Our research examines whether the distribution of Sphaeriid clams in western Lake Erie have declined similar to unionid mussels, as a step to enhancing the overall picture of impacts from the invasive dreissenids. Strayer has reported for the Hudson River that sphaeriid diversity initially declined after the dreissenid invasion, but after a significant die-off of D. polymorpha, a condition present in Lake Erie, densities of native species rebounded. Multiple standard ponar samples of Sphaeriid clams were made by the Ohio Environmental Protection Agency at 12 Western Basin stations and several more from the Central Basin as by-catch from mayfly-larva sampling in the summers of 2012-2014. Preliminarily, members of Sphaerium are rare, M. transversum are common as are at least several species of Pisidium.

**Supported by the McNair Scholars Program*

Investigating Rhoptry Gene Conservation between Plasmodium yoelii and Plasmodium falciparum using the Polymerase Chain Reaction for DNA Amplification

College of Sciences and Health Professions

Student Researcher: Brooke Burkhalter

Faculty Advisor: Tobili Sam-Yellowe

Abstract

In order to obtain a tangible basis for vaccine targets, it is crucial to understand the role of proteins at the site of invasion. In previous study, 27 novel rhoptry proteins were identified by MudPIT analysis and immunoelectron microscopy. In this investigation, the conservation of rhoptry genes between *Plasmodium yoelii* and *Plasmodium falciparum* was assessed. From the previously identified rhoptry genes, 14 were investigated with the orthologues/paralogues of the *Plasmodium falciparum*, *Plasmodium yoelii, Plasmodium chabaudi*, and *Plasmodium berghei*. Also, primers designed for the 14 *Plasmodium yoelli* rhoptry genes were used to test DNA amplification with the PCR. Amplification of *Plasmodium falciparum, Plasmodium yoelii,* and *Plasmodium chabaudi* gDNA was accomplished with the designed primer set for the *Plasmodium yoelii* rhoptry gene PY07825.

**Supported by the McNair Scholars Program*

Control of Meiotic Cell Divisions in Presence of Unrepaired chromosome breaks

College of Sciences and Health Professions

Student Researchers: Francisco Monge, Jesus Monge, Andrew Reville, and Rima Sandhu

Faculty Advisor: Valentin Boerner

Abstract

Chromosome miss-segregation during meiosis is a major factor contributing to birth defects as well as many genetic anomalies through the formation of aneuploid gametes, i.e. gametes with a deficit or surplus of one or several chromosomes. The synaptonemal complex (SC) is a major protein structure assembled with the synapsis of homologous chromosomes and is conserved from unicellular yeast to humans. One of its major roles during prophase I in meiosis is providing a structural framework for the maintenance of synapsis to facilitate the completion of reciprocal crossover events. Failure to form an effective SC or to experience crossover events leads to a cellular arrest in prophase I of meiosis. Through a genetic screen, our lab has identified a Nobel gene that suppresses cellular arrest in cells with specific mutations that cause chromosome mis-segregation. In our series of experiments we seek to garner a greater understanding of this Nobel gene's function in the bypass of similar mutations leading to a prophase I cellular arrest. In the model organism budding yeast (*S. cerevisiae*), the ZIP1 protein polymerizes to form the transverse filaments that assist in maintaining the stability of the SC. Studies of the synaptonemal complex have exposed an understanding of a relation between recombination and mis-segregation. A mutation of the Zip1 gene is an example of these anomalies resulting in meiotic cellular arrest delineating similar results to those produced by a deletion mutant of the strand invasion protein Dmc1. Our lab now demonstrates an effective suppression of the cellular arrest resulting from Zip1C1 as well as that produced by a deletion mutant of Dmc1. Further understanding of this Nobel gene and its pathway are being advanced at the present in the distinction of its relation to different proteins involved in the processing double strand breaks (DSB).

Role in Recombination of Genes That Control Meiotic Cell Divisions

College of Sciences and Health Professions

Student Researchers: Andrew Reville, Francisco Monge, Jesus Monge, and Rima Sandhu

Faculty Advisor: Valentin Boerner

Abstract

The production of gametes in Saccharomyces cerevisiae via meiosis is under strict regulatory control where proper segregation of homologous chromosomes into gametes requires physical linkage via crossovers. Cells that initiate meiotic recombination but do not process programmed double strand breaks into crossovers enter meiotic arrest. The main goal of the current project was whether overexpression of gene Y is sufficient to bypass the meiotic arrest in prophase I exhibited by dmc1 deletion and a zip1 mutant that carries an internal deletion. DMC1 is a recombinase that promotes homologous recombination. ZIP1 is a transverse filament protein of the synaptonemal complex (the structure that forms between homologous chromosomes) and is integral in homologous recombination and proper segregation of chromosomes. Gene Y encodes a protein of unknown function in the S. cerevisiae genome that we tagged with GFP and overexpressed using an inducible promoter. Our main goal was to determine the minimum concentration of a given inducer at which gene Y is sufficiently overexpressed to bypass the arrest. We found that when overexpressing gene Y, the meiotic arrest is bypassed fully for cell cultures in sporulation medium with induction at both t=3.5 hours and 6.5 hours, over the span of 24 hours in synchronous meiotic cultures. There was also a bypass of the meiotic arrest in both the high and low concentrations of inducer added to the meiotic cultures. Bypass is achieved at the lower concentration, where there is reduced chance of induce toxicity.

TMCO1 mediates cancer cell migration through regulating microtubule assembling

College of Sciences and Health Professions

Student Researchers: Pau Romaguera Llacer, [1]Qiaoxia Zheng, and Qiaoyun Zheng

Faculty Advisor: Aimin Zhou

Abstract

Transmembrane and coiled-coil domains 1 (TMCO1) is highly conserved in amino acid sequence among species and ubiquitously expressed in all human tissues. Homozygous frameshift mutation in TMCO1 causes distinctive craniofacial dysmorphism, skeletal anomalies, and mental retardation. However, its physiological functions, particularly in cancer biology, are largely unknown. In this study, we have found that knock down of TMCO1 in HeLa cells, a human cervical cancer cell line, and U2OS cells, an osteosarcoma cell line, remarkably inhibited their migratory capability; TMCO1 was highly expressed in the cells of the invasive front of high grade lung cancer and metastatic cancer cells in the clinical specimens, and lung cancer cells at the metastatic bone site in our animal model; Immunohistostaining revealed that TMCO1 was co-localized with microtubules and was able to be co-sedimentated with microtubules in the presence of paclitaxel and GTP; and deficiency of TMCO1 in cells dramatically increased acetylation of tubulin. Further investigation demonstrated that TMCO1 impacted microtubule dynamics, which is closely correlated with cancer metastasis, TBA drug response and therapeutic prognosis. Our findings provide not only new mechanistic insights into cancer metastasis, but also critically evaluate the significance of TMCO1 as a novel target for therapeutic treatment of the disease.

[1]Insitute of Molecular Medicine, Beijing University, China

Lead optimization of tubulin inhibitor for cancer treatment

College of Sciences and Health Professions

Student Researcher: Morgan Ashcraft

Faculty Advisor: Bin Su

Abstract

Tubulin-containing structures are important for many important cellular functions, including chromosome segregation during cell division, development and maintenance of cell shape, cell motility, and distribution of molecules on cell membranes. The rapid growth of cancer cells makes them very sensitive to the disruption of tubulin polymerization/depolymerization. Taxol (paclitaxel), a tubulin inhibitor approved by the FDA in 1992 for cancer treatment, is one of the most powerful chemotherapeutic agents. However, the low water solubility and drug resistance limits its clinical application. Various effort in drug discovery field focuses on more water soluble smaller molecular tubulin inhibitors. Our previous study led to the discovery of tubulin inhibitors with IC_{50}s below 1nM to inhibit cancer cell proliferation, and these compounds have much small molecular weight than Taxol. In addition, our compounds showed promising in vivo anti-cancer activity as well. To further improve the druggable characteristics of our drug candidates, we focus on the ligand efficiency of these compounds in the current proposed study. A series of new analogs were designed and synthesized, and their structures were elucidated with NMR spectrum. Their anti-cancer activity was determined with breast cancer cell lines. Several new compounds exhibited promising anti-cancer activity.

Optimizing the design and potency of diterpenic acid derivatives to improve cell membrane permeability and Hsp27 targeting characteristics

College of Sciences and Health Professions

Student Researcher: Aicha Quamine

Faculty Advisor: Bin Su

Abstract

Heat shock protein 27 (Hsp27) acts as a protective protein allowing it to play an integral role in aiding cancer cell resistance. Stress-induced Hsp 27 overexpression aids in the stabilization of partially denatured proteins to establish protein refolding resulting in thermotolerance, inhibition of apoptosis, cytoprotection, etc. As a result of rapid proliferation and general instability, cancer cells exhibit increased dependency on the support of Hsp 27 and it's chaperone proteins, therefore generating an ideal target for anticancer therapy. Copalic acid, a clerodane diterpenoid, has already been confirmed in effective chaperone inhibition and antiproliferative synergistic effect. We hypothesize that by optimizing the structure of Copalic acid derivatives to increase solubility and drug potency we will increase anti-chaperone activity thereby hindering phosphorylation of Hsp27 affecting cell proliferation and stability. combinatorial chemistry strategies were used to develop and modify Copalic acid derivatives while synthesizing various dimers to enhance potency. Through utilizing NMR to identify synthesis alterations and MTT colorimetric assay we will continue to monitor and optimize the derived compounds.

**Supported by the McNair Scholars Program*

Mechanism of action by which 5-NIdR acts as a therapeutic agent against brain cancer

College of Sciences and Health Professions

Student Researchers: Seol Kim, [1]Jung-Suk Choi

Faculty Advisor: Anthony J. Berdis

Abstract

Approximately 10,000 people in the United States are diagnosed annually with a brain tumor. In addition, the prognosis for brain cancer patients is poor as these cancers have low survival rates of less than 10%. One important chemotherapeutic agent used to treat brain cancer is temozolomide, an alkylating agent that causes cell death by damaging DNA. In this project, we tested the ability of a specific non-natural nucleoside developed in our lab, designated 5-NIdR, to increase the efficacy of temozolomide against brain cancer. Animal studies using xenograft mice were performed to evaluate the *in vivo* efficacy of this drug combination against brain cancer. Results indicate that treatment with 5-NIdR does not affect the rate of tumor growth compared to treatment with vehicle control. While treatment with temozolomide slows the rate of tumor growth by 2-fold, more striking results are obtained when 5-NIdR is combined with temozolomide as this drug combination causes complete tumor regression within two weeks of treatment. To better define the cellular mechanism for this effect, a series of cell-based studies were performed to compare the cytotoxic effects of temozolomide alone and in combination with 5-NIdR. Flow cytometry experiments measuring Annexin V staining as a marker for apoptosis demonstrate that cells treated with 5-NIdR and temozolomide accumulate show significantly higher levels of apoptosis compared to cells treated with 5-NIdR or temozolomide alone. Experiments measuring cell-cycle progression demonstrate that treatment with 5-NIdR and temozolomide causes cancer cells to accumulate at S-phase before undergoing apoptosis. The block at S-phase likely results from the ability of 5-NIdR to inhibit the replication of damaged DNA created by temozolomide. Consistent with this mechanism, significantly higher levels of single- and double-strand DNA breaks are detected in cancer cells treated with 5-NIdR and temozolomide compared to cells treated individually with either agent. Collectively, these studies provide additional pharmacological evidence for combining 5-NIdR and temozolomide as a possible treatment strategy to effectively treat brain cancers.

[1]*Post-doctoral Fellow*

Nitrosylation of S100A8/ A9 protein complex by inducible Nitric Oxide Synthase

College of Sciences and Health Professions

Student Researcher: Kia Smith

Faculty Advisor: Valentin Gogonea

Abstract

How does the body fight infection? What causes inflammation? These are only a few questions that have been asked by many doctors across the globe. One thing that is known for certain about infection is that there is a particular sub-group of enzymes called NOS's (eNOS, nNOS and iNOS) that produce Nitric Oxide (NO), a molecule radical capable of oxidizing proteins and alter their function. In our study we focus on inducible Nitric Oxide Synthase (iNOS). NOS's are comprised of oxidase and reductase domains liked by Camodulin (CAM), a polypeptide linker. According to prior studies and SEM photographs, inducible Nitric Oxide's input and output states were analyzed showing the enzyme as highly malleable molecule virtually creating a shape-shifting enzyme capable of various shapes, however, the internal placement of the oxidase and reductase domain within iNOS is not clearly understood. As a result, the method of transport for NOwas not revealed. This enzyme is responsible for the releasing of NOthroughout the body when activated. NOthen targets sites of infection and as a result, causes inflammation in the effected area. The true question is, what method of transport does iNOS use to safely transfer NO(a protein nitrosylating agent) throughout the body as NOis known to be a highly reactive substance. Our computational research study utilized a protein-protein docking program (PatchDock) and a molecular visualizer (PyMol) in order to gain a digital grasp of the transfer path of the NOmolecule to NO-carrier proteins like S100A9.

**Supported by the McNair Scholars Program*

Cell Surface Sialylation Status of Monocytes and Macrophages

College of Sciences and Health Professions

Student Researchers: Henry Wang and Dan Wang

Faculty Advisor: Xue-Long Sun

Abstract

Sialic acids (SAs), a family of 9-carbon containing acidic monosaccharides, often terminate the glycan structures of cell surface glycoconjugates such as glycoproteins and glycolipids. The levels and linkages of sialic acids named as sialylation status vary as cell environment changes related to both physiological and pathological processes. Changes in sialylation of cell surface modulate cellular activity. SAs are highly involved in the immune system, however, the sialylation status related to individual immune cells and their activation state and functions are still unknown. In this study, we used a newly developed LC-MS/MS method to examine the cellular SA content during THP-1 monocytes differentiation into macrophages. The expression level of SAs on the cell surface is affected by its biosynthetic pathway. In particular, the synthetic enzyme, sialyltransferase, functions for adding SAs to the termini of *N*-linked or *O*-linked glycans on the cell surfaces. In this study, the change of SA was further confirmed by western blot on the sialyltransferases level. This work will abound in the approaches of SAs study, and also contribute to a better understanding of the physiological and pathological roles of SAs in the immune system.

Development of a GC-MS Method for Investigation Mouse Plasma Amino Acid Levels and their Significance to the Circadian Clock

College of Sciences and Health Professions

Student Researcher: Kylin Emhoff

Faculty Advisors: Yana Sandlers and Roman Kondratov

Abstract

An extraction procedure and gas chromatography mass spectrometry (GC-MS) method was developed for quantitation of plasma amino acids. The experimental workflow included extraction of amino acids from plasma, followed by derivatization protocol for GC-MS compatibility. Automated Mass spectral Deconvolution and Identification System (AMDIS) and laboratory developed library was used for compound identification. Levels of plasma amino acids were calculated based on one point calibration with non-physiological amino acid L-norvaline as internal standard.

The assay was applied to obtain and monitor levels of plasma amino acids to study the effect of feeding restriction on the circadian clock in mice. The circadian clock is an evolutionarily conserved molecular machinery that consist of transcription-translation feedback loops, which oscillate throughout the day and produce rhythms that dictate the behavior and physiology of all living organisms. At the center of the circadian clock are CLOCK and BMAL1 that regulate various metabolic processes such as mTOR signaling and coordinate them with daily rhythms. Results of our current study show that the amino acids oscillate during the day but do not correlate with the feeding paradigm. Due to presence of multiple peaks, it can be concluded that the oscillations are not circadian in nature, which suggests probable complex regulation of amino acids.

Can we increase the intensity of pro-active balance exercises?

College of Sciences and Health Professions

Student Researchers: Joshua Lilly and Elizabeth Antonik

Faculty Advisors: Debbie Espy and Ann Reinthal

Abstract

Balance training has been shown to be effective in preventing or lessening the severity of falls among older adults. This training can be proactive or reactive; however, the relative effectiveness of each and the necessary dosages are not known. The purpose of this research was to adapt an existing protocol for slip testing (reactive training) and video-game balance training (proactive) to better accommodate the abilities of older adults. We tested iteratively the initial protocols, set-ups, and equipment with a group of adults age 55 years and older and devised new protocols and equipment for each. After observing the subjects' participation in the original protocol and taking into account their feedback, we made changes to four major areas of the protocol: the slipping protocol and equipment, the gaming surfaces, the harness, and the videogames themselves. We decreased the percentages for the slip distance and the slip weight in the slipping protocol, lessening the perturbation to better suit the physical abilities of older adults, and lengthened the slipping platform. We created three different gaming surfaces using mats and pool rafts, each with a distinct level of balance difficulty. A new harness was implemented into the protocol, one that allows for a wider range of stepping motion. Lastly, we modified the videogames, adding special rules and instructions that encouraged the subjects to play more aggressively while still remaining safe.

Balance training application of a systematic framework for clinical decision making in therapeutic gaming for older adults

College of Sciences and Health Professions

Student Researcher: Brian Boccieri

Faculty Advisor: Ann Reinthal

Abstract

Falling is a major health concern for older adults. Balance is crucial in order to prevent falls. For balance to be functional an individual must be able to maintain balance while focusing on other tasks. For example, an individual must focus on more than just staying upright during walking while drinking a mug of coffee, or during standing while washing dishes. There are a countless number of daily activities that challenge balance. One of the problems with current clinical balance rehabilitation is that the training is often completed using isolated exercises that do not include the various other cognitive and perceptual components that occur concurrently in real life activities. Training balance using video games addresses this problem because it is more similar to real world activities that require balance. Gaming's virtual reality nature means that there are multiple varied but simultaneous personal, task, environmental elements.

As with any exercise prescription, to realize maximum therapeutic benefit, the training must match the individual's needs and goals. However, people's balance skills vary based on the activities in which they participate. For example, an older adult who participates in gardening will have an easier time moving between standing and kneeling than someone who rarely gets on the floor in daily life activities. The framework provides the detailed analysis necessary in order to tailor video gaming to adequately challenge each individual's specific balance exercise prescription requirements.

**Supported by the McNair Scholars Program*

Safe Movement Practices by STNAs for Residents in Nursing Homes

College of Sciences and Health Professions

Student Researcher: Christine Fortuna

Faculty Advisor: Glenn Goodman

Abstract

Previous research reports that with compliance, safe movement programs and policies play a large roll in reducing worker injury and safe patient handling. The purpose for our research is to better understand the daily safe movement practices of State Tested Nursing Assistants as it relates to the safe handling and transferring of patients. We used Qualtric software to electronically survey 14 STNAs from Jenning's Center for Older Adults Upper Level Neighborhood. The survey consisted of 7 forced choice questions and 19 open ended or follow up questions. The scope of our research covers the complexities of the daily tasks of STNAs and the injuries acquired during patient transfers. It also addresses education, implementation, and barriers of safe movement police and practices, job satisfaction and overall happiness, as well as mental and physical healthy behavior practices. The results of our research show that the profession of STNA is very physically and mentally demanding. Our research confirmed results reported in the literature that the most common work related injuries acquired by STNAs were to the lower back. Results show that half of the participants report they never or almost never physically exercise. Over half of the participants reported that in performing their job duties they were unable to comply with OSHA and BWC recommendations to avoid independently lifting more than 50 pounds. Although many opportunities were given for additional comments, most STNAs were reluctant to provide more information. Over 75% of the participants report being very happy with their job role as an STNA.

Acoustic Objective and Subjective Measurements of Noise Levels in Various Places of Worship and the Potential Consequences on the Auditory System

College of Sciences and Health Professions

Student Researcher: Celeste Thomas

Faculty Advisor: Myrita Wilhite

Abstract

The purpose of this study is to record the objective and subjective measurements of noise levels in ten religious institutions of various faiths: Apostolic/Pentecostal, Baptist, Catholic, Muslim, Non-Denominational, and Seven-Day Adventist places of worship within the greater Cleveland area; in conjunction with the assessing the hearing sensitivity of the ministerial staff members who are most susceptible to prolonged noise exposure. The objective is to generate a statistical analysis of the objective acoustical measurements of primary church services of all participating religious institutions determine if the noise levels are loud enough to cause potential harm to the auditory system. The researcher would like to raise awareness for hearing conservation programs within religious organizations. Participants: Select ministerial workers of each faith: Pastor/Rabbi/Priest /Imam, wives of religious leaders, ministers of music, and musicians. 20 people were asked evaluate the noise level of their primary religious services. Methods: The acoustical measurement outcomes of each denominations primary church service was recorded with an Extech 40730 Digital model Sound Level Meter at various locations within the church sanctuary/tabernacle/synagogue/mosque. Evaluation assessment sheets asked for the ministerial staff's perception of loudness, in four subjective categories: exceptionally loud, moderately loud, somewhat loud, and not loud. Every ministerial leader was given a pure-tone and impedance hearing screening using a Maico portable.

**Supported by the McNair Scholars Program*

Statistical Analysis of DASI Questionnaire and Modeling the Prediction of Heart Failure Risk in Patients

College of Sciences and Health Professions

Student Researcher: Christian Negron

Faculty Advisor: Yuping Wu

Abstract

9,880 patients were asked to complete the DASI questionnaire along with other questions to assess the predictability of heart failure risk. In this paper we attempt to reduce the amount of questions asked by hierarchical clustering of the question responses to determine if there is a change in the predictability of heart failure risk in patients. The data was modeled using Cox hazards multiple regression and validated through ROC and AUC. Our validation models show there is no difference between the usage of 12 and 6 DASI questions, therefore improving the simplicity of the questionnaire. *Abbreviations: DASI, Duke Activity Status Index.*

**Supported by the McNair Scholars Program*

Dynamics of an optically trapped particle

College of Sciences and Health Professions

Student Researcher: Justin Flaherty

Faculty Advisor: Andrew Resnick

Abstract

Particles trapped in a laser experience a linear restoring force that keeps them centered in the trap and will undergo restricted Brownian motion. The Brownian motion causes a change in the scattered laser light. The scattered light is projected onto a Quadrant Photodiode and can be used to obtain the Mean Squared Displacement of the particle, as well as the linear spring constant of the laser trap. The spring constant can be used to obtain the force applied by the laser trap, which is in the realm of piconewtons.

Ciliary Mechanosensation in MDCK cells

College of Sciences and Health Professions

Student Researcher: Muhammad Tayeh

Faculty Advisor: Andrew Resnick

Abstract

Cilia are microscopic structures that extend from the surface of mammalian cells. Cilia can be categorized into two groups, primary cilia (non-motile) and motile cilia. Cilia are composed of tubulin subunits (microtubules) and covered by a plasma membrane. The physiological role of motile cilia has been very well documented, but the function of primary cilia remains largely unknown. It has been shown that primary cilia allow cells to sense and respond to mechanical stimuli. The ability for a cell to respond to mechanical stimuli is crucial for maintaining processes such as homeostasis. It has also been shown that defects in cilia can be matched up with different diseased states. Primary cilia have shown to regulate the release of intercellular calcium in response to fluid flow. There is a correlation between the disruption of primary cilium function and the formation polycystic kidney disease. To understand and measure the mechanical properties of primary cilia optical tweezers will be used. Calcium imaging technique will also be used to show the Ca+2 status of the cell. The goal of this work involved the use of the cell line MDCK (Madin-Darby canine kidney) to uncover the mechanical properties of primary cilia.

Developing affordable wet-sample electron microscopy integrated with a temperature controlled sample holder

College of Sciences and Health Professions

Student Researcher: Dan Terrano

Faculty Advisors: Petru Fodor and Kiril A Streletzky

Abstract

Scanning electron microscopy (SEM) is widely used to analyze the size, shape and composition of material systems. However, using this tool for analyzing systems such as particles suspended in solution, requires drastic sample alterations, such as precipitation and fixation. Besides altering their environment, this exposes the particles to the harsh conditions within an electron microscope, such as high vacuum and electron beam exposure. To this end, the first goal of this study was to develop methodologies for imaging wet samples using electron microscopy. This is realized by creating a sandwich structure containing the solution of interest between a partially electron transparent window and a silicon substrate. The ability of the developed imaging cells to provide good imaging conditions is demonstrated with a variety of samples including polystyrene spheres, polymeric microgels and spindle shaped nanoparticles. As some of the systems investigated are temperature sensitive, the second goal of the project was to develop a temperature controlled stage that can be integrated with the SEM. In the future this heating stage will be used alongside the wet samples to image microgels above and below their critical solution temperature.

Synthesis of optimal polymeric microgels and their characterization with light scattering

College of Sciences and Health Professions

Student Researchers: Christan Gunder and Daria Kulyk

Faculty Advisors: Kiril A Streletzky and Petru Fodor

Abstract

Polymeric microgels were synthesized in by chemically crosslinking hydroxypropylcellulose (HPC) chains with each other in aqueous solutions of sodium hydroxide at temperatures above the low solution critical temperature (LCST) of HPC. In order to create a narrower size distribution of HPC microgels, surfactant (dodecyltrimethylammonium bromide, DTAB) was added. It was found that, LCST of the solution moved from ~40C up to 80C with an increase in DTAB concentration from 0 to 12 g/l. Formed microgels were be characterized by dynamic light scattering (DLS). Microgel solutions synthesized so far resulted in reasonably monodispersed nanoparticles between the sizes of 150-90 nm below the known LCST for HPC, and 90-50 nm above the known LCST for HPC. Surprisingly some of the microgels revealed weak VH signal, indicating their potential geometric anisotropy. Further studies were done in an attempt to explore the effect of synthesis temperature and crosslinker concentration and microgel size, polydispersity, and swelling ratio. It was found that maintaining a pH of 12 for the aqueous sodium hydroxide solvent was critical to ensure reproducibility of synthesis. However, it was also found that the pH of the solvent had no effect on the overall LCST of the HPC in DTAB-free solutions.

Deducing Shape of Anisotropic Particles in Solution from Light Scattering: Spindles and Nanorods

College of Sciences and Health Professions

Student Researchers: Ilona Tsuper and Dan Terrano

Faculty Advisor: Kiril A Streletzky

Abstract

Depolarized Dynamic light scattering (DDLS) enables to measure *in* situ rotational and translational diffusion of nanoparticles suspended in solution. Their size, shape, diffusion, and intermolecular interactions can be interred then from DDLS data using various models of diffusion. Incorporating DDLS to analyze the dimensions of easily imaged elongated particles, such as Iron (III) oxyhydroxide Spindles (FeOOH) and gold coated Nanorods, will allow a deeper understanding between rotational/translational diffusion and size distribution of hard-to-image anisotropic wet systems such as micelles, microgels, and protein complexes. The emphasis of this study was to look at the aged FeOOH Spindle sample, and explore the size distribution and modeling of the Nanorod particles. The light scattering results obtained from the basic model of non-interacting prolate ellipsoids offered dimensions similar (within 15%) to the size distribution from the Scanning Electron Microscope (SEM). The results, however, were somewhat different from the original particle size possibly due to sample aging and agglomeration of the FeOOH Spindles. Conversely, the Nanorod dimensions obtained from the Prolate Ellipsoid Model differed by a factor 1.2-2 from the values obtained by Transmission Electron Microscopy and SEM. The significant difference between DDLS and imaging results is due to the nature of the modeling employed (ellipsoid was used to model cylindrically shaped particles with spherical caps).

Case Transition Format and Lexical Decision Performance: Does Spacing Reduce the Benefit of Orthographic Regularity?

College of Sciences and Health Professions

Student Researchers: Kristyn Oravec, Maryam Assar, and Hannah Princic

Faculty Advisor: Albert F. Smith

Abstract

Some models of visual word identification propose that identification is analytic—mediated exclusively by letter identification. However, some studies have shown that there are phenomena that suggest a route to word identification involves holistic stimulus properties. In previous research, using a lexical decision task, in which participants are asked to determine whether letter strings are words or nonwords, we have found that response times to orthographically regular words (i.e., lowercase, uppercase, and initial uppercase formats) are faster than those to orthographically irregular words (i.e., words that include a case transition other than initial uppercase to lowercase). In this experiment, we investigated whether spacing between letters reduces the benefit of orthographic regularity. Sixteen students participated in a lexical decision experiment in which items varied in spacing and case-transition format. Items were either packed (e.g., BEAR) or spaced (e.g., B E A R); there were eight different case-transition formats (e.g., bear, BEAR, Bear, bEAR, beaR, BEAr, beAR and BEar). We found that at both spacings, response times for orthographically regular forms (e.g., bear, BEAR, Bear) were faster than those for orthographically irregular forms. Spacing had no overall effect on response times for words, and did not reduce the benefit of orthographic regularity.

Preliminary Investigation of the Role of Open Bigrams in Word Perception: Is There a Benefit to Having Flankers That Consist of Letters in the Word?

College of Sciences and Health Professions

Student Researchers: Maryam Assar, Kristyn Oravec, Hannah Princic, and Amy Palinski

Faculty Advisor: Albert F. Smith

Abstract

Most investigators of word identification agree that information is processed through a hierarchical system in which units at progressively higher levels respond to features, letters, letter combinations (e.g., pairs, or bigrams), and possibly words. Grainger et al. (2014) found support for the role of adjacent-letter bigrams in an experiment in which participants saw target strings flanked by bigrams, such as BI BIRD RD and CE BIVS NT, and judged whether the targets were words. They found, for words, that flanking bigrams facilitated performance when the flanking bigrams contained letters from the target, and that the order of bigrams relative to the word did not affect performance (e.g., performance did not differ for BI BIRD RD and RD BIRD BI). We replicated Grainger et al's procedure. Consistent with their findings, we found, for words, better performance when flankers contained letters from the target than when they did not. However, we did not replicate Grainger et al.'s crucial finding of better performance when flanking bigrams' letter order matched the target's order of letters (e.g., BI BIRD RD and RD BIRD BI) than when the bigrams letter order flipped (e.g., IB BIRD DR and DR BIRD IB).

The effect of depression symptoms on the cardiac autonomic response to positive mood induction

College of Sciences and Health Professions

Student Researchers: Elizabeth Golias, Khadeja Najjar, Brock Bodenbender, and Ilona Ponomariova

Faculty Advisor: Ilya Yaroslavsky

Abstract

Depression is characterized by a reduced capacity to experience pleasure (hedonic capacity). A growing literature suggests that hedonic capacity is supported by the sympathetic (SNS) and parasympathetic (PNS) branches of the autonomic nervous system. Both branches may work in a reciprocal fashion, or in tandem, reflecting co-activation of the SNS and PNS. While reduced PNS and increased SNS activity are associated with happy states among healthy individuals, preliminary findings suggest that depressed persons evidence blunted physiologic responses across a variety of emotion inducing stimuli. Much of this work, however, has examined PNS and SNS activity separately, and never with respect to hedonic stimuli. We examined whether depression symptoms and low hedonic capacity are associated with jointly blunted autonomic activity across the two branches.

Twenty-nine participants completed measures of depression, state hedonic capacity, and trait hedonic capacity. Physiologic baseline and reactivity to a happy film clip were also collected. SNS and PNS co-activation during baseline significantly predicted reduced state and trait hedonic capacity. Blunted reciprocal PNS and SNS reactivity to the film clip predicted elevated depression symptoms and hedonic capacity at trend levels. Clinical implications are discussed.

Autonomic Nervous System response to interpersonal exclusion in Borderline Personality Disorder

College of Sciences and Health Professions

Student Researchers: Ilona Ponomariova, Brock Bodenbender, Khadeja Najjar, and Elizabeth Golias

Faculty Advisor: IlyaYaroslavsky

Abstract

Intense emotional reactions to interpersonal rejection reflect the core of Borderline Personality Disorder (BPD). These reactions supported by the autonomic nervous system (ANS), which has been linked to neural regions that undergird emotional experience and regulation that are affected among individuals with BPD. Despite such links, relatively few studies have examined ANS functioning among BPD populations. The few studies that have primarily focused on the independent activity of the two sympathetic (SNS) and parasympathetic (PNS) ANS branches during resting states or in response to emotion evocative films, rather than to interpersonal rejection. The present study overcomes the above noted gaps in the literature by examining the combined effects of SNS and PNS activity in response to interpersonal rejection on BPD symptoms. It was hypothesized that strong increase in SNS activity and strong decrease in PNS activity would be associated with elevated BPD symptoms.

Twenty-eight participants (68% female, *M*age= 29.64) completed a measure of BPD and a protocol during which SNS and PNS activity were measured over a 3-minute resting period and in response to an interpersonal exclusion task (Cyberball). Consistent with expectation, reduced PNS dominance during the interpersonal exclusion task was robustly predicted elevated BPD symptoms. Clinical implications are discussed.

Cultural Differences in Coping and Depression between Individuals of Middle-Eastern and Non-Arab Backgrounds

College of Sciences and Health Professions

Student Researcher: Khadeja Najjar

Faculty Advisor: Ilya Yaroslavsky

Abstract

The Middle Eastern (Arab) demographic is a growing, yet neglected cultural group in mental health research. While Arabs are more predisposed to depression than other ethnic groups in US, little is known about mechanisms that account for this risk. One set of mechanisms may be the use of ineffective (maladaptive) coping or insufficient use of effective (adaptive) coping responses, which are robust predictors of depression in US samples, but virtually unexamined in Arabs. Further, the effect of a coping is influenced by culture, which, for Arabs, may change as a function of acculturation. Thus, the present study aimed to examine whether: (1) individuals of Arab decent differ from non-Arabs with respect to coping efforts used in response to stress, (2) cultural differences in coping responses explain disparities in depression risk across the Arab & non-Arab cultural groups, and (3) the degree that Arab identity accounts for cultural differences in coping responses and depression.

Ninety-six participants (86% female, Mage = 26.66, SD = 9.68; n=61 Arabs) were recruited from Arab-affiliated organizations throughout the US and online resources. Participants anonymously completed online measures of Arab identity, adaptive and maladaptive coping responses, and depression symptoms.

Results showed that Arab participants used fewer adaptive coping responses ($F(7, 87)=2.12$, $p < .05$) and more maladaptive responses relative to those of non-Arab backgrounds ($F(6, 84)=2.64$, $p < .05$). Specifically, those of Arab backgrounds reported being less likely to seek emotional support, and to more frequently use denial and behavioral disengagement when coping with stress. In particular, behavioral disengagement was associated with depression ($\beta=.57$, $p < .001$), and mediated the relationship between an Arab cultural background and depression symptoms ($\beta=.19$, $p < .01$). The positive relationship between behavioral disengagement and depression symptoms, however, was observed only for non-Arabs and Arabs with a low Arab identity. Clinical implications are discussed.

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Enhancement of Solar Energy Conversion in Bio-derived Cells via Side Selective Modification of Photosystem I

College of Sciences and Health Professions

Student Researchers: Uchechukwu Obiako and Evan Gizzie

Faculty Advisor: Dr. David Cliffel, Vanderbilt University

Abstract

Deleterious effects of some methods used to harness energy from the environment today have garnered the exploration of safer and more reliable options, specifically solar energy conversion. Current solar cell technology has yielded quantum efficiencies commonly in the range of 10-20% but is limited by extensive processing methods, high cost, and need for rare materials. However, bio-derived solar cells containing Photosystem I (PSI) address these problems as PSI is highly abundant, very efficient, and low-cost. PSI acts as a biomolecular photodiode through rapid photoexcited charge separation, making it very promising for use as an integral element in solar cells. To further improve the efficiency of bio-derived cells, controlling the orientation of PSI films on gold substrates was explored. This was achieved by side-selectively modifying PSI to introduce terminal thiol groups to the protein complex thereby providing a vector of self-assembly onto the gold surface. Spinach thylakoid membranes containing PSI were extracted and chemically modified using the ligands: sulfo-N-succinimidyl S-acetylthioacetate and 2-iminothiolane. As a result, the functionalized PSI underwent direct surface coupling on gold electrodes in an inverted orientation. Fluorescence tagging was used to quantify ligand attachment to PSI. Additionally, photoelectrochemical analysis revealed an enhancement in photocurrent produced by the modified biohybrid electrodes.

**Supported by the McNair Scholars Program*

Designing Tuftsin Conjugate for Directing Antimicrobial Ionophores to Macrophages

College of Sciences and Health Professions

Student Researchers: Sokhna Seck and Zeenat Razvi

Faculty Advisor: Katherine J. Franz, Duke University

Abstract

For all microorganisms, acquisition of metal ions is essential for survival in the environment or their infected host. Metal ions are required in many biological processes as cofactors for proteins or structural elements for enzymes. These ions play a role in chemotaxis, phosphorylation, transport of sugars and proteins, and initiation of DNA replication, among other things. It is critical for bacteria to ensure that metal uptake and availability meet its physiological needs; too little can impede these important biological processes, while too much can be toxic leading to radical formation which can cause damage to proteins and cell structures (Porcheron, Gaëlle. et al. 2013). Host defense strategies against infection consist of metal starvation by sequestration using chelators or metal overload with concentrated amounts of metals using ionophores (Norris, V et al. 1996). Ionophores are lipid-soluble molecules that transport ions across a cell membrane. Pyrithione, an ionophore, is a well-known antimicrobial used to control the symptoms of dandruff and dermatitis. It inhibits fungal and bacterial cell division and is active against different bacterial systems such as E. coli and C. neoformans; it has also been found to be toxic to mammalian cells (Helsel, M et al. 2012). The aim of this research project is to target pyrithione to the site of infection - in macrophages. Tuftsin (Thr-Lys-Pro-Arg) is known to be responsible for activation of macrophage cell lines. It is internalized through a receptor-mediated mechanism by macrophages and conjugates can be made without affecting this recognition (Feng, J et al. 2010). Attaching pyrithione to tuftsin would target the ionophore to macrophages, allowing for specificity to pathogens.

**Supported by the McNair Scholars Program*

Feasibility and Effects of Accelerometer Based Feedback on Paretic Upper Extremity Amount of Use in the Home Setting in Subjects Chronic Post-Stroke

College of Sciences and Health Professions and Washkewicz College of Engineering

Student Researchers: Nathan Pohl, Amber Kuehn, and Mishgan Abdullah

Faculty Advisors: Maureen Whitford and Eric Schearer

Abstract

Purpose : to (1) evaluate the feasibility of using accelerometers in the home to quantify how much subjects chronic post-stroke (PS) use their upper extremities (UE), (2) measure differences between amount of UE movement in subjects PS and a healthy control group (HC), (3) determine the effects of accelerometer based feedback on paretic UE use in subjects PS, and (4) determine if those effects are retained over time.

Methods : Six subjects PS wore accelerometers for 3 weeks with two feedback sessions given during week two. Seven HC subjects wore accelerometers for one week. Accelerometer based outcome measures included relative paretic or nondominant UE time active (overall, 1 handed, 2 handed), and arm ratio (paretic/nonparetic or nondominant/dominant). Statistical analysis (SPSS v. 22.0) was preformed to evaluate differences and relationships.

Results : 11 of 13 subjects (of varying severity of impairment post-stroke) completed the entire study confirming feasibility in the home. HC subjects had significantly higher amount of use than subjects PS ($p < 0.04$) for all outcome measures. There was no significant increase in amount of use for subjects PS after receiving feedback ($p > 0.56$), but some subjects had increased amount of use for some of the outcome measures.

Effects of Accelerometer Based Feedback on Clinical Measures and Paretic Upper Extremity Amount of Use in Subjects Chronic Post-Stroke

College of Sciences and Health Professions and Washkewicz College of Engineering

Student Researchers: Amber Kuehn, Nathan Pohl, and Mishgan Abdullah

Faculty Advisors: Maureen Whitford and Eric Schearer

Abstract

Purpose/Hypothesis: To determine the effects of accelerometer based feedback on clinical measures of paretic upper extremity (UE) recovery in people post-stroke and examine the relationship between these changes and paretic UE amount of use (AOU) measured by an accelerometer.

Subjects: 7 people chronic post-stroke (5 males, 2 females; aged 62.03 ± 11.33 years) with an Upper Extremity Fugl-Meyer score range of 10-63 were included for this poster.

Materials/Methods: Subjects wore wrist accelerometers for 3 weeks in the home. Clinical measures (Motor Activity Log, Stroke Impact Scale, Chedoke Arm and Hand Activity Inventory, and the ABILHAND) were assessed weekly. Data analysis included a repeated measures ANOVA and Pearson correlations.

Results: Improvements and declines were present for clinical measures in individual subjects, but group changes were insignificant ($p = 0.11$, $p = 0.23$). No significant relationships were found between the change in clinical measures and paretic UE AOU. There was a trend for subjects with greater impairments post-stroke to have greater nonparetic UE use.

Conclusions: Feedback led to insignificant improvements in clinical measures, but these were not retained. Effects, which appeared to vary based on stroke severity and individual perception, may not have been retained due to short treatment period.

Effect of Accelerometer Based Feedback on Paretic Upper Extremity Amount of Use and Quality of Movement: A Case Study

College of Sciences and Health Professions and Washkewicz College of Engineering

Student Researchers: Mishgan Abdullah, Nathan Pohl, and Amber Kuehn

Faculty Advisors: Maureen Whitford and Eric Schearer

Abstract

Purpose/Hypothesis: To determine the effects of accelerometer based feedback on clinical measures of paretic upper extremity (UE) recovery in people post-stroke and examine the relationship between these changes and paretic UE amount of use (AOU) measured by an accelerometer.

Subjects: 7 people chronic post-stroke (5 males, 2 females; aged 62.03 ± 11.33 years) with an Upper Extremity Fugl-Meyer score range of 10-63 were included for this poster.

Materials/Methods: Subjects wore wrist accelerometers for 3 weeks in the home. Clinical measures (Motor Activity Log, Stroke Impact Scale, Chedoke Arm and Hand Activity Inventory, and the ABILHAND) were assessed weekly. Data analysis included a repeated measures ANOVA and Pearson correlations.

Results: Improvements and declines were present for clinical measures in individual subjects, but group changes were insignificant ($p = 0.11$, $p = 0.23$). No significant relationships were found between the change in clinical measures and paretic UE AOU. There was a trend for subjects with greater impairments post-stroke to have greater nonparetic UE use.

Conclusions: Feedback led to insignificant improvements in clinical measures, but these were not retained. Effects, which appeared to vary based on stroke severity and individual perception, may not have been retained due to short treatment period.

**Partially Supported by the McNair Scholars Program*

The Profitability of Plagiarism: A Look at University Plagiarism Policies Across the Country

Maxine Goodman Levin College of Urban Affairs

Student Researchers: Emily Kiesel and Christen Obojski

Faculty Advisor: Joseph Mead

Abstract

Like health care, higher education is one of the relatively few areas where for-profit, public, and nonprofit organizations directly compete with one another. This creates a robust policy debate about the role of for-profits in the delivery of educational services, and provides a window to study widely believed but mostly untested views about differing institutional behaviors in different sectors. Prior literature has found mixed results about student outcomes from for-profit colleges, and existing data on educational quality across sectors have yet to be identified. In this study, we coded various information from the written academic dishonesty policies of a large random sample of American universities issuing bachelor's degrees. We hypothesized that the profit motive would tend to push for-profit colleges to prize tuition dollars over policing academic integrity norms, which would push for-profit colleges to adopt policies that impose more lenient punishments for students caught in misbehavior. Our data did not support this hypothesis, as we did not find for-profit college policies to be distinguishable from nonprofit or public college policies in severity of punishment. However, religious affiliation was statistically significant with a more *lenient* maximum penalty, and in some models, the percentage of staff devoted to student support and the graduation rate were associated with stricter minimum penalties. The data also indicate that Cleveland State University's policies on academic misconduct are among the most lenient in the United States, particularly with regard to assignments worth less than 25% of the course grade, which suggests that it may be time to revisit this university's approach to plagiarism.

Processing Conditions for Ultrastable Surfactant-Free Nanoparticle Stabilized Foams

Washkewicz College of Engineering

Student Researchers: William Ivancic and Richard Schmitt

Faculty Advisor: Christopher Wirth

Abstract

Foams, which are mixtures of gas and either a liquid or solid, are important to many applications, from consumer products to industrial processes. Stabilizing the liquid/gas interface against coalescence is key to the performance of foams. Typically, molecular surfactants (surface active agents) are used for interfacial stability, but adsorption/desorption of surfactant can diminish foam performance. We investigated the use of solid nanoparticles, rather than surfactants, as stabilizers. Fumed silica nanoparticles of varying surface chemistry, ranging from hydrophobic to hydrophilic, were suspended at 1% (w/w) and agitated in solutions of water and ethanol. Foam (gas in liquid), suspensions, and inverse foam ("liquid marbles") structures formed during agitation; these materials were classified into a structure map as a function of processing conditions. We found the agitation intensity, solution chemistry, and surface chemistry of the fumed silica nanoparticles had a profound effect on the final structure and that there was an envelope of optimal processing conditions for producing foam. Coalescence was mitigated for 49 days as of writing this abstract. Superior stability arises from the large energy necessary to remove particles with suitable chemistry from an interface. Thus, both the energy input and system chemistry are central to designing ultrastable foams.

The Catalytic Gasification of Waste Polymers: Determining the Kinetics of the Sabatier Reaction

Washkewicz College of Engineering

Student Researchers: Eric M. Lange, Samuel O. Sanya, Aliandra Barbutti, Stephen A. Reeves, and Joshua M. Cmar

Faculty Advisor: Jorge Gatica

Abstract

This research focuses on advancing the knowledge of a catalytic gasification process as a potential in-situ resource utilization and waste management alternative. This research has significance in a variety of engineering applications, but it is of particular relevance towards reducing landfill waste or as an in-situ resource generation system for space exploration beyond Low Earth Orbit (LEO).

This process evolves through a reaction mechanism consisting on two liquid-phase oxidation reactions of long-chain polymers, complemented by two gas-phase reactions. This project focusses on one of the gas phase reactions: one of the main fuel producing reactions, the Sabatier (also referred to as "methanation") reaction. The primary focus of this project is to analyze experimental data collected for this reaction, and to determine the kinetic parameters of the Sabatier reaction.

The research is an outgrowth to previous kinetic determinations available for the reaction. Indeed, the data used to perform the kinetic analysis was originally collected by Lunde and Kester in the 1970s (*Ind. Eng. Chem., Process Des. Dev., Vol. 13, No. 1, pp. 27-32, 1974*). The kinetic analysis presented here is based on fundamental reactor design equations and was accomplished using numerical techniques not readily available at the time of Lunde and Kester's analysis. The experimental data was split into two sets of data: one set used for parameter estimation, and second set to be used for validation purposes. Comparison with the original approach followed by Lunde and Kester is also provided.

Experimental Analysis of Catalytic Gasification of Polyethylene

Washkewicz College of Engineering

Student Researchers: Samuel O. Sanya, Aliandra Barbutti, Eric M. Lange, Jade Moten, Stephen A. Reeves, and Joshua M. Cmar

Faculty Advisor: Jorge Gatica

Abstract

Over the last century there has been a global interest in reducing/recycling waste material as well as creating energy from renewable and more eco-friendly sources. Catalytic gasification is one effective method that can promote low-temperature conversion of solid waste to energy, also referred to as "gasification". The gas mixture produced by gasification of long-chain polymers using ruthenium (or platinum) catalysts consists of hydrogen, methane, carbon monoxide, carbon dioxide, and water.

Product mixtures of gasification experiments were analyzed by Gas Chromatography (GC) and post-processed using statistical analysis. Using fundamental reactor design equations along with stoichiometric calculations yielded the percent gasified as well as the reaction selectivity of the process.

The solid residues containing ashes, char, ruthenium, and polyethylene unreacted were analyzed in a Differential Scanning Calorimetry (DSC) and a Scanning Electron Microscope (SEM) to identify its components. Quantification of the DSC spectra was used to correlate the thermal characterization of the residues with the unconverted (or non-gasified) after the reaction was quenched. Lastly, the SEM provided information on the microstructure of the residues, their atomic composition, and preliminary assessment of the possibility of catalyst recovery.

These results are next to be used in formulating a kinetic mechanism for the liquid-phase oxidation, and thus complete a model of catalytic gasification amenable for scaling-up the process to continuous operation.

Creating miniaturized tissue constructs on a micropillar/microwell chip via 3D bioprinting technology

Washkewicz College of Engineering

Student Researchers: Yana Sichkar, Pranav Joshi, and Akshata Datar

Faculty Advisor: Moo-Yeal Lee

Abstract

Liver tumor tissues in the human body consist of different layers of hepatic cells including hepatoma cells and surrounding normal cells. To mimic *in vivo* tumor tissues, three-dimensional (3D) microarray bioprinting was demonstrated on a microwell chip via layer-by-layer printing of Hep3B human hepatoma cell line. The 3D microarray printing coupled with high-content imaging (HCI) of cell layers on the chip might open new opportunities for predictive drug screening for patients. Our goal is to demonstrate high-throughput cell printing in hydrogel layers and establish HCI of cell layers from the microwell chip for miniaturized tumor tissue engineering. To achieve this goal, Hep3B cell suspension stained with TMRM and Hoechst 33342 was mixed with alginate as well as photocrosslinkable alginate and then printed onto the microwell chip using a microarray spotter. The images of Hep3B cells encapsulated in two alginate layers were acquired by scanning the chip with a chip scanner. As a result, we successfully demonstrated two layer cell printing with Hep3B cells encapsulated in alginate and establish high-throughput HCI with fluorescently-labeled Hep3B cells at different z-focus positions. To improve imaging of cells in different layers, further optimization of gelation conditions with photocrosslinkable alginate will be necessary.

Tuning the Size of Elastin-like Polypeptide Nanoparticles

Washkewicz College of Engineering

Student Researcher: Adam Maraschky

Faculty Advisor: Nolan B. Holland

Abstract

The ability to control the size of biologically-based, environmentally-sensitive colloidal nanoparticles can advance their application in areas such as drug delivery, tissue engineering, and biosensors. Controlling size is a primary task in engineering nanomaterials because many of their properties depend on size. With the aim of fine-tuning the size of particles, we characterize mixtures of two elastin-like polypeptide structures: a linear and a trimer configuration. Both constructs undergo aggregation above their inverse transition temperatures, but the linear ELP forms large aggregates which coalesce into a protein-rich phase, while the ELP trimer with polar head groups forms stable polymer micelles in low salt concentrations. The mixing of these two constructs makes possible a range of sizes of stable particles through the formation of a microemulsion. The linear ELP fills the cores of the micelle aggregates, resulting in larger stable particles. We determined the dependence of particle size on both the salt and linear ELP concentration across a range of temperatures using UV-vis spectroscopy and dynamic light scattering (DLS). We find that a given mixture of linear and trimer constructs has two temperature-based transitions and therefore displays three predominant size regimes. The results help elucidate the mechanisms of ELP aggregation.

Characterizing Stimuli-Responsive Materials for Drug Delivery: Interactions with Model Compounds and pH Responsive Behavior

Washkewicz College of Engineering

Student Researchers: Ryan Martin and Eric Helm

Faculty Advisor: Nolan B. Holland

Abstract

Stimuli responsive elastin-like polypeptide (ELP) nanoparticles are a promising platform for targeted drug delivery. Our laboratory has developed ELP nanoparticles that can specifically target cancer cells and provide contrast for MRI imaging. In order to utilize this system for drug delivery, the ability to carry and release drugs needs to be determined. Partition coefficients of drugs in ELP systems are one important measure of a system's ability to transport drugs, while a pH response mechanism can be utilized to provide selective drug release. In this study, we investigated the partition coefficients of seven model drug compounds in a pH responsive ELP system. The thermally responsive transition behavior of this system was also determined. Model compounds were loaded into protein solutions and allowed to separate between a protein-rich phase and an aqueous phase. The phases were separated and partition coefficients were determined by the ratio of concentrations determined by high performance liquid chromatography (HPLC). The thermal transition behavior was determined by turbidity measurements using UV spectroscopy over a range of pH values and protein concentrations. This study is an important step in establishing an effective system of pH responsive ELP drug delivery nanoparticles.

Effect of Solidification through Cross-Section Change on Dendritic Array in Single Crystal Castings

Washkewicz College of Engineering

Student Researchers: Christopher Stacey and Masood Ghods

Faculty Advisor: Surendra Tewari

Abstract

Dendritic single crystal turbine blades are the most critical component in a gas turbine engine. These are made by directional solidification in ceramic molds having many cross-section changes. Abrupt cross-section changes during casting are the source of casting defects, such as, freckles and spurious grains. Purpose of this study was to examine the role of convection associated with cross-section changes in producing microstructural defects. Al-7%Si alloy was directionally solidified at 11, 29 and 73 μm s^{-1} in graphite crucibles having abrupt cross-section decrease and cross-section increase to simulate solidification of turbine blades. It is observed that, (i) shrinkage flow leads to composition inhomogeneity in the vicinity of section decrease and (ii) spurious grains form after section increase. It is therefore, important to minimize convection in the melt by selecting alloy compositions which minimize the change in melt density due to composition changes occurring during solidification.

Community perceptions on substance abuse by underage

Washkewicz College of Engineering

Student Researchers: Wyatt Suntala and Navid Changizi

Faculty Advisor: Mehdi Jalalpour

Abstract

In the spring of 2015, the Community Awareness and Prevention Association (C.A.P.A.), and westshore young leaders network (WYLN) developed and conducted a Community Perception Survey (CPS) of adult residents in the suburbs of Lakewood, Rocky River, Fairview Park, Bay Village, Westlake, and North Olmsted. The purpose of the survey was to assess attitudes and opinions about substance abuse and prevention efforts of WYLN. The survey was both anonymous and confidential. The CPS resulted in 955 usable data which were analyzed and visualized at CSU. The results showed a strong perception of alcohol abuse and accessibility to alcohol for teens by other parents. Women were more likely to perceive greater access and abuse of alcohol by teens than men, and men were more permissive with the use of alcohol by teenagers. Parents with children from grade 9 up to college were also more likely to perceive alcohol as a greater threat and were more involved/aware of community preventive efforts.

Laboratory and Field Testing of High Performance Repair Materials

Washkewicz College of Engineering

Student Researchers: Michelle Seitz, Jennifer Woods, and Larisa Suskinsas

Faculty Advisor: Norbert Delatte

Abstract

The Ohio Department of Transportation has identified the need to specify durable, more permanent high performing pavement and bridge deck patching materials that allow for expediting pavement and bridge deck wearing surface repair for worker and user safety. Currently, either temporary or generally specified in-kind or like materials are being used to perform pavement patching. There is a current research project underway examining the performance of various high performance repair materials both in the laboratory and the field. The goals and objectives of this research project are:

- Identify/determine acceptable field performance criteria for comparative analysis of selected products.
- Install the products at mutually agreed locations as described herein.
- Evaluate the products based on field performance criteria.
- Provide updated field performance evaluation criteria based on the field performance analysis.
- Provide a comprehensive standard material and performance based generic specifications in the Standard ODOT Construction and Material Specifications or Supplemental Specifications format based on desired ASTM or equivalent material properties and field performance analysis.
- Provide a decision matrix for use of the recommended products as set forth in the deliverables section.

Learning to Drive a Simulator: Impact of Prolonged Practice

Washkewicz College of Engineering

Student Researchers: Eyal Greenhouse and Samah Soki

Faculty Advisor: Jacqueline Jenkins

Abstract

Most driving simulation experiments begin with a practice scenario, to allow participants to learn how to interact with the driving simulator. During practice, driving performance improves such that consistent steering and speed control is exhibited. It is unclear however, whether driver performance will degrade with prolonged practice, and whether the fidelity of the simulator contributes to this degradation. Therefore, a driving simulation experiment was conducted to examine the performance of drivers over one hour of driving, using two different simulators: DriveSafety RS-100 and RS-600 models. The RS-100 is made up of a Logitech steering wheel and pedals attached to a mock-up of a cab, with a single 24'' LCD monitor. The RS-600 consists of force feedback controls inside a partial Ford Focus cab, with five HD flat screens.

Twenty participants, thirteen males and seven females, between the ages of eighteen and fifty-eight (average age of twenty-five), were asked to drive an uneventful (i.e. no traffic) road with a repetitive pattern of straight and curved sections. Participants were divided equally into two groups: half driving the RS-100 and the other half driving the RS-600. Various driving performance measures were recorded (e.g. velocity, lane position, acceleration, steering, etc.). The data was examined for trends in driving behavior over time, as well as differences between the two simulators. The results on both simulators indicate a short learning period after which participants maintain constant speed. Lane keeping data did not show any improvement over time; however, the data shows that it was easier to maintain lane position driving on straight segments and driving the RS-100 model.

Power Electronics Design for a Transfemoral Prosthesis

Washkewicz College of Engineering

Student Researcher: Taylor Barto

Faculty Advisor: Dan Simon

Abstract

Prosthetic legs do not always properly emulate a human leg. However, recent advances have allowed prostheses to include motors and brakes in order to closely mimic the performance of human legs. Unfortunately, motorized prostheses are often inefficient, which results in a dependence on batteries. This project aims to use energy regeneration methods to increase the operating time of motorized prostheses. Regeneration occurs when the leg requires braking; instead of using an energy-wasting braking mechanism, energy flows through an electronic circuit into a bank of supercapacitors. The energy can also flow in the reverse direction so that the motors can be powered by the supercapacitors when the prosthesis needs positive energy. In this research, the flow of energy is regulated by two different control methods which are compared through computer simulations. The physical component values and control parameters are optimized with two different evolutionary algorithms using a low-fidelity simulation. Results from the simulations are analyzed so that the electronic circuitry can be integrated into a higher fidelity simulation that includes a mechanical model of a transmission and friction.

Robotics Training: Fundamentals of Robot Assembly and Programming

Washkewicz College of Engineering

Student Researchers: Mike Iannicca and Brandon Rutledge

Faculty Advisor: Dan Simon

Abstract

Smartphones have become the central communication and computing devices in our daily life because of their nearly ubiquitous Internet access through various communication capabilities such as WiFi, 3G, or even 4G networks, their user-friendly interfaces supporting touch and gesture based input, and their numerous applications and games. Operating system (OS) detection, the first step to launch security attacks on a target smartphone, enables an adversary to tailor attacks by exploiting the known vulnerabilities of the target system. We investigate OS identification against smartphones that use encrypted traffic. We evaluate the identification algorithms against collected smartphone traffic. The experiments results show that the algorithms can identify a smartphones OS accurately.

Computer Vision and Route Planning for Humanoid Robots

Washkewicz College of Engineering

Student Researchers: Brandon Rutledge and Mike Iannicca

Faculty Advisor: Dan Simon

Abstract

Today humans control robots. Eventually, robots will control other robots. This research is a step in that direction. The goal of this research is to enable the NAO humanoid robot to take a picture of a VEX mobile robot and a colored cube, and analyze the picture so that the NAO can control the VEX to fetch the cube. The picture is examined by the NAO one pixel at a time. Using predetermined color values, the cube, along with the front and back of the VEX, are located, and the center points of each are calculated. The angle that the VEX needs to turn, and the distance that it needs to move, are calculated by the NAO. The NAO communicates this information to the VEX by a wireless remote control device which it manually manipulates. The VEX is programmed to receive input from the remote control and to determine from that input how it needs to move. Once the VEX reaches the cube, it closes its claw to retrieve the cube. The NAO then repeats the process, this time moving the VEX back to the NAO.

Parallel Selection Algorithms on GPUs: Implementation and Performance Comparison

Washkewicz College of Engineering

Student Researcher: Darius Bakunas-Milanowski

Faculty Advisor: Janche Sang

Abstract

The computing power of current Graphical Processing Units (GPUs) has increased rapidly over the years. They offer much more computational power than recent CPUs by providing a vast number of simple, data parallel, multithreaded cores. In this project, we focused on the study of different variations of parallel selection algorithms on the current generation of NVIDIA GPUs. That is, given a massively large array of elements, we were interested in how we could use a GPU to efficiently select those elements that meet certain criteria and then store them into a target array for further processing. The optimization techniques used and implementation issues encountered are discussed in detail. Furthermore, the experiment results show that our advanced implementation performs an average of 1.74 times faster than Thrust, an open-source parallel algorithms library.

Integrating an Android Device into Embedded Computer Systems

Washkewicz College of Engineering

Student Researcher: Eric Payne

Faculty Advisor: Pong Chu

Abstract

An embedded system is a computer system designed to perform a specific set of tasks such as a GPS device or a digital camera. An embedded system is composed of three major parts: a processor (CPU), input devices, and output devices. The input devices are peripherals to take user command (switches and keypad) and sensors to measure environmental conditions (barometer and accelerometer). The output devices are actuators that generate light and sound (LED display and amplified speaker) and moving parts (servo motor).

An important step in prototyping an embedded system is to design the input subsystem. It is traditionally done by selecting input modules and then developing hardware and software interfaces for each individual module. The undergraduate summer research is to use an inexpensive, entry-level, Android phone as a universal programmable sensor module. It provides a single unified interface and can be configured to replace a dozen commonly used input devices.

Prosthetic Socket Surface Initialization – For Future Use in Subject-Specific Socket Optimization

Washkewicz College of Engineering

Student Researcher: Brahm Powell

Faculty Advisors: Jason Halloran and Mehdi Jalalpour (mentor)

Abstract

For persons with lower limb amputations the human-prosthesis interface, termed the "prosthetic socket," remains an area of ongoing research. Patient satisfaction is closely tied to the physical comfort of the device, which includes performance factors such as fit, moisture management, stiffness/rigidity, stress concentrations, range of motion, etc. An imbalance in these factors may result lack of mobility for the patient or worse, pressure sores, a precursor to debilitating deep tissue ulcerations. Ulcerations are well documented and current socket fitting techniques, as performed by a "prosthetist," are largely subjective, relying on the prosthetist's experience and feedback from the patient.

With the goal to achieve easy to manufacture patient-specific prosthetic socket designs, the technical aim of this work was to develop one critical aspect of a proposed work flow. Specifically, this work covers development and evaluation of an approach for creation of parametrized socket geometry. Accessible parameters that define a socket's geometry are easily updated during iterative computer simulations, which are to be developed in future work. Initial results yielded an undesirable number of variables at the desired accuracy, yet the method appears well suited for description of other complex geometries.

Characterization of Rotor Aerodynamics of the Laboratory-scale Miniature Wind Turbines

Washkewicz College of Engineering

Student Researchers: Jason Wolf and Jordan Thomas

Faculty Advisor: Wei Zhang

Abstract

Wind energy has become a major contributor to energy production from renewable sources and is expected to increase its portion to the overall energy supply. Wind-tunnel testing of miniature wind turbine models plays an important role in understanding the turbine wake effects and interactions of wind farms with the incoming flow. However, previous research has often not carefully quantified the rotor aerodynamic characteristics of the mini wind turbines, i.e., how the power and thrust coefficients vary with respect to the tip speed ratio, and to what extent they represent the field-scale wind turbines. This work focuses on developing a robust method to measure the power and thrust coefficients and control the tip speed ratio. Using a series of resistors to change the resistance of the circuit, we can control the tip speed ratio of the model and estimate the power coefficient. The thrust coefficient is measured directly using a 3-component force balance. Results from two independent measurements are compared with the theory. Wake generation of the mini-wind turbine is also observed by flow visualization. This research serves as a foundation to design mini-wind turbines that can better match the field-scale wind turbine aerodynamic characteristics.

Ultra-high resolution simulations of the atmospheric boundary layer across the shores of Lake Erie

Washkewicz College of Engineering

Student Researcher: Stephen Kennedy

Faculty Advisors: Thijs Heus and Wei Zhang

Abstract

An accurate assessment of wind speeds at various heights and locations is important in the deployment of wind turbines. This study focuses on assessing wind speeds and their trends across the shores of the Lake Erie by unsteady, three dimensional, Large Eddy Simulations (LES) with a horizontal resolution of 50m. In a previous study the Weather Research and Forecasting (WRF) was used for the same region with a coarser resolution of 3km. It did not consistently predict the wind speeds, especially for a well-known nocturnal phenomenon—the Low Level Jet.

Our LES code, DALES (Dutch Atmospheric Large Eddy Simulation), seems to show better performance in this scenario by correctly predicting the Low Level Jet. We also performed sensitivity tests in terms of grid resolution, exact location with respect to the shore, and large-scale advection.

Using a Fourier analysis we estimate the amount of energy at scales that were unresolved by WRF, were wind turbines would not be able to convert to electricity, but would potentially be damaged by the fluctuations instead.

Privacy-Aware Computer-Vision Based Human Motion Tracking

Washkewicz College of Engineering

Student Researchers: Connor Gordon and Abou-Bakar Fofana

Faculty Advisor: Wenbing Zhao

Abstract

Computer-vision based human motion tracking has undergone intensive research for the past several decades. As exemplified by Microsoft Kinect, inexpensive portable computer-vision based motion sensors can now be used to accurately track human motions in many application domains, particularly in the healthcare area, such as rehabilitation exercises, fall detection, and safe patient handling. However, such computer-vision based technology is rarely used in venues such as hospitals and nursing homes, primarily due to privacy concerns. Even if a patient or a health caregiver has consented to being monitored, the vision-based motion sensor cannot guarantee that only the consented person is tracked due to the indiscriminative nature of the vision technology itself: anyone in its view might be automatically tracked.

The primary objective of this project is to create a set of methodologies and a companion framework that facilitate privacy-aware human motion tracking, which include: (1) Privacy-aware human motion tracking. A consented subject is required to wear a programmable wearable device, such as a smart watch. One or more programmable depth cameras are used to track the activities of the consented subject. Discriminative tracking is achieved by a registration mechanism executed when the subject enters the view of a camera and periodically while the subject stays in the view. The registration mechanism identifies the consented subject in the view of the camera by matching a predefined set of gestures that are simultaneously captured by both the wearable device and the depth camera. After the registration step, only the consented subject is tracked and the motion data collected for all non-consented subjects will be discarded immediately. (2) Real-time human activity recognition based on a set of invariance rules that dictate the expected correct movements, and realtime haptic feedback delivered via the wearable device worn by a consented subject.

Selective Plane Illumination Microscopy

Washkewicz College of Engineering

Student Researcher: David Ian Pendleton

Faculty Advisor: Kristen Maitland, Texas A & M University

Abstract

Selective plane illumination microscopy (SPIM), or light sheet microscopy, is a microscopy technique that allows you to acquire high resolution fluorescence images of biological samples by illuminating the sample with a thin plane from the side, instead of along the imaging axis as in traditional transillumination or epi-illumination. The purpose of this SPIM research assignment was to combine two previously built systems, an inverted SPIM and a tunable lens system. This report includes use of optics, coupling lasers and proper technique to building optical systems. Programming in Matlab, LabVIEW, and other programming languages was used to synchronize the shutter and camera electronics and acquire and process images. The paper is concluded with expected results to ensure to detection path is optimized.

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