

**Forward Thinking Poster Session/Colloquy Presentation  
Past Award Recipients**

**2017**

**Comparing Regenerative Abilities in New Caledonian Geckos**

Tony Gamble, Assistant Professor, Biological Sciences  
Aaron Griffing

**Dairy-Manure-Derived Catalyst for Energy and Resource Recovery from Wastewater Biosolids**

Zhongzhe Liu, Research Assistant Professor, Civil, Construction and Environmental Engineering  
Matthew Hughes

**Quantification of Dispersal Patterns of Invasive Insects with Unmanned Aerial Systems**

Henry Medeiros, Assistant Professor, Electrical and Computer Engineering  
Miguel Hernandez Virto, Brian Stumph and Weihua Liu

**2016**

**Cancer-Related Fatigue, Mitochondrial Function, and Exercise in Cancer Survivors.**

Alexander Ng, Associate Professor, Physical Therapy/Exercise Science  
Aidan Flanagan

**Using a Dual Viral Approach to Evaluate Stress-Induced Drug Seeking.**

John Mantsch, Professor, Biomedical Sciences  
Michael Nordness

**Biosolids Reuse: Continuous Flow-Through Column Testing of Biosolids-Derived Biochar to Sorb Micropollutants**

Patrick McNamara, Assistant Professor, Civil, Construction and Environmental Engineering  
Brooke Mayer, Assistant Professor, Civil, Construction and Environmental Engineering  
Lee Kimbell

**Social Innovation Awards:**

**A Mobile Method for Determining Access Ratings for the Built Environment**

Sheikh Iqbal Ahamed, Professor, Mathematics, Statistics, and Computer Science  
Drew Williams  
Amit Kumar Saha

**The Mediating Effects of Perceived Social Support and Positive Thinking on the Relationship**

Abir Bekhet  
Denis Matel-Anderson

**2015**

**An Intersectional Investigation of Minority Stress Theory**

Ed de St. Aubin, Associate Professor, Psychology  
Lauren Yadlosky

**mHealth System for Patients with Arthritis**

Sheikh Iqbal Ahamed, Professor, Mathematics, Statistics and Computer Science  
Taskina Fayezeen, Md Osman Gani

**Improving Services to the Hispanic Community through Technology-Enhanced Pronunciation Training of L2 Spanish-Speaking SLPs**

Steven Long, Associate Professor, Speech Pathology and Audiology  
Sonia Barnes, Assistant Professor, Foreign Languages and Literatures  
Jeffrey Berry, Associate Professor, Speech Pathology and Audiology

Julissa Bello-Almazan, Mahala Berry

**Social Innovation Award:**

**Monitoring Learning Capability in Autistic Populations Using Sensors**

Sheikh Iqbal Ahamed, Professor, Mathematics, Statistics and Computer Science

Amy Van Hecke, Associate Professor, Psychology

Niharika Jain, Piyush Saxena

**2014**

**The Role of Biocides in Antibiotic Resistance in Wastewater Treatment**

Dr. Patrick McNamara, Assistant Professor, Civil, Construction and Environmental Engineering,

Dr. Daniel Zitomer, Professor, Civil, Construction and Environmental Engineering,

Daniel Carey

**Removal of Environmental Estrogenic Micropollutants from Wastewater Solids**

Dr. Patrick McNamara, Assistant Professor, Civil, Construction and Environmental Engineering,

Dr. Daniel Zitomer, Professor, Civil, Construction and Environmental Engineering,

Thomas Hoffman

**Resilience in Adolescents Who Survived a Suicide Attempt from the Perspective of the Registered Nurse in a Psychiatric Facility**

Dr. Abir Bekhet, Assistant Professor, College of Nursing,

Denise Matel-Anderson

**2013**

**Recovering from Foreclosure: An Experimental Study of a Community Outreach Campaign**

Dr. Amber Wichowsky, Assistant Professor, Political Science,

Colleen Ross, Anabelle Martinez, members of POSC 4281

**Anaerobic Membrane Bioreactor for Sustainable Wastewater Treatment**

Dr. Daniel Zitomer, Professor, Civil, Construction and Environmental Engineering, Matt Seib

**Sensorimotor Adaptation of Connected Speech using Multiple Acoustic Cues**

Dr. Jeff Berry, Assistant Professor, Speech Pathology and Audiology; Dr. Michael T. Johnson, Professor, Electrical and

Computer Engineering, Brittany Bernal

**2012**

**Porting XINU to Raspberry Pi**

Dr. Dennis Brylow, Associate Professor, Mathematics, Statistics and Computer Science, Matthew Bajzek, Farzeen

Harunani, and Tyler Much

**Neural Responses to Social Skills Intervention in Adolescents on the Autism Spectrum: An Extension of the PEERS Research Project**

Dr. Amy Vaughn Van Hecke, Assistant Professor, Psychology and Sheryl Stevens

**Case Study of the Implementation of the Co-principalship in a K-8 School District**

Dr. Ellen Eckman, Associate Professor, Educational Policy and Leadership and Amy Porter

**2011**

**Legal and Extra-Legal Factors Impacting Domestic Violence Injunctions in Milwaukee**

Dr. Heather Hlavka, Assistant Professor, Social and Cultural Sciences; Dr. Sameena Mulla, Assistant

Professor, Social and Cultural Sciences, Kate Hanson, and Chelsea Pierski

**The Human Powered Nebulizer in the Treatment of Airway Diseases in El Salvador**

Dr. Lars E. Olson, Associate Professor, Biomedical Engineering; Dr. M. Therese Lysaught, Associate Professor, Theology; Christopher Hallberg, Clinical Trial Coordinator; Ellen Hawkinson, Katelynn Kramer, Brian Laning, Sarah Schmiedel, and Andrew Weingart

**Parent and Family Outcomes of PEERS: A Social Skills Intervention for Adolescents with Autism Spectrum Disorders**

Dr. Amy Vaughn Van Hecke, Assistant Professor, Psychology, and Jeffrey Karst

**2010**

**The Amader Gram Breast Care Palliation Study: Phase 1**

Dr. Sheikh Iqbal Ahamed, Associate Professor, Mathematics, Statistics and Computer Science, Ferdous Kawsar, Mohammad Tanviruzzaman, Md. Munirul Haque, and Mohammad Adibuzzaman

**Speech Adaptation for Rehabilitation**

Dr. Jeffrey J. Berry, Assistant Professor, Speech Pathology and Audiology and Mary Bolgert

**The Halo Effect of Faith Communities: An Exploratory Study on Crime and Religious Social Capital**

Dr. Noreen E. Lephardt, Adjunct Assistant Professor, Economics and Brenden Mason

**Role of Mechanical Stress in LPS-Induced Damage of Periodontal Cells in Vitro**

Dr. Dawei Liu, Assistant Professor, Orthodontics and Yaroslav Yarmolyuk, DDS

**2009**

**The Influence of Cultural Variables on Latino/a Adolescent Sexual Activity**

Dr. Lisa Edwards, Assistant Professor, Counselor Education and Counseling Psychology, Brittany N. Barber and Keyona Jarrett

**Effects of Mechanical Vibration on Orthodontic Tooth Movement**

Dr. Dawei Liu, Assistant Professor, Orthodontics and Andrew Rummel

**Pre-service Elementary Teachers' Knowledge of Relational Thinking**

Dr. Marta Magiera, Assistant Professor, Mathematics, Statistics, and Computer Science; Dr. John Moyer, Professor, Mathematics, Statistics, and Computer Science; Dr. Leigh van den Kieboom, Assistant Professor, Educational Policy and Leadership, Ashley Zenisek and Edwin O'Sullivan

**2008**

**Role of Endurance Exercise Training in Protection of Ischemic Heart Disease**

Dr. Robert Fitts, Professor and Chair, Biological Sciences, Ms. Patricia Colloton, Research Associate, and Brooke Rogers

**Contribution of the Frontal Lobes to "Successful Aging"**

Dr. Kristy A. Nielson, Associate Professor and Chair, Psychology, and Andrew Newsom

**Novel Properties of Bean Root Nodules Harboring a Bacterial Respiratory Mutant and What These Properties May Reveal about Oxygen-triggered Regulation of the Symbiosis**

Dr. Dale Noel, Professor, Biological Sciences, and Robert Stone

**What's the Best Rehabilitation Prescription? Identifying Factors that Enhance Recovery of Gait after Stroke**

Dr. Sheila Schindler-Ivens, Assistant Professor, Physical Therapy, and Shannon Knoblauch

**2007**

**A Pilot Study to Develop a Behavioral Intervention to Support Self-regulated Pushing during Second Stage Labor: A Focus Group of Certified Nurse-Midwives as Informants**

Dr. Lisa Hanson, Associate Professor, Nursing, and Kathryn Osborne

**Mold Detection using Acoustic Wave Sensors**

Dr. Fabien Josse, Professor, Electrical and Computer Engineering; Dr. Susan Schneider, Associate Professor, Electrical and Computer Engineering, and Meetalee Dalal

**Father Involvement in Caring for Adolescents with Diabetes: An Investigation Piloting New Techniques in Pediatric Research**

Dr. Astrida Kaugars, Assistant Professor, Psychology, and Christopher J. Fitzgerald

**2006**

**Mentoring and Collaboration: Undergraduate, Graduate and Professional Research in Literature and Law**

Dr. Christine L. Krueger, Associate Professor & Director of Core Curriculum, English, and Colleen Willenbring and Kaye Wierzbicki

**Role of CamKinase Alpha in Renewal and Reinstatement of Fear**

Dr. Matthew J. Sanders, Assistant Professor, Psychology, and Jocelyn Miller

**Imaging of the Human Brain during Pedaling**

Dr. Sheila Schindler-Ivens, Assistant Professor, Physical Therapy, and Jay Mehta

**2005**

**Cross-Cultural Development and Testing of the Risk Information Seeking and Processing (RISP) Model**

Robert J. Griffin, Professor, Journalism, Franziska Borner, Jan Gutteling, Associate Professor and Ellen Ter Huurne, doctoral student, University of Twente, The Netherlands

**Neurotoxicity of BMAA in Cortical Cultures**

Doug C. Lobner, Associate Professor, Biomedical Sciences, and Peachy Mae T. Piana

**Sexism and Rape Myth Acceptance: A System Justification Perspective**

Debra L. Oswald, Assistant Professor, Psychology, and Kristine Chapleau

**Marquette International Research Poster Session  
Award Winners**

**2017**

*Psychometrics Properties of the Arabic Version of the Positive Thinking Skills Scale (A-PTSS) among First Generation Middle East Immigrants*

Dr. Abir Bekhet

Associate Professor, College of Nursing

**2016**

*"Molecular diagnosis of multi Schistosome parasites from filtered urine from school children in Zambia."*

Dr. Nilanjan Lodh

Assistant Professor, Clinical Laboratory Science

**2015**

*"International Research to Improve Planning, Care and Functional Outcomes in Children with Orthopaedic Disabilities: Manila Philippines."*

Dr. Gerald Harris

Professor, Biomedical Engineering

**2014**

*"Engineering Synthetic Feedback to Promote Recovery of Self-feeding Skills in Stroke Survivors." (in partnership with the University of Genoa)*

Dr. Robert Scheidt, professor, Biomedical Engineering

Alexis Krueger, graduate assistant, Biomedical engineering

*"The Nahuatl in Central American Mapping project."*

Dr. Laura Matthew, associate professor, History Department

Benjamin Nestor, graduate assistant, History Department

**2013**

*"Designing Human-Computer Interfaces for Elderly People in Taiwan"*

Dr. Sheikh Iqbal Ahamed

Professor, Mathematics, Statistics and Computer Science

*"Untold Stories: An African Society and the Second World War (Nigeria)"*

Dr. Chima J. Korieh

Associate Professor, History Department

Judges:

Dr. Joyce Wolburg, Associate Dean and Professor, Diederich College of Communication

Dr. Lars Olson, Interim Bio-Medical Chair, Biomedical Engineering

**2012**

*"The Mechanism of 'Chinese Traditional Teeth Tapping' in Maintaining Alveolar Bone"*

Dr. Dawei Liu, DDS

Associate Professor, Dental Developmental Sciences/Orthodontics

*"mHealthMTT: Bridging the Gap in Communication Using a Mobile Based Intervention for Maternal and Child Healthcare in Rural Bangladesh"*

Dr. Iqbal Ahamed

Associate Professor, Mathematics, Statistics and Computer Science

Judges:

Dr. Anne Pasero, Chair and Professor of Spanish, Foreign Languages & Literatures

Dr. James Marten, Chair/Professor, History

Ms. Michelle Schuh, Assistant Dean, College of Health Sciences

**2011**

*“Circulations: Death and Opportunity in Southern Pacific Mesoamerica, 1450-1620”*

Dr. Laura Matthew

Assistant Professor, History

*“Findings from the deployment of e-ESAS: a remote symptom monitoring system for rural breast cancer patients in Bangladesh”*

Dr. Iqbal Ahamed

Associate Professor, Mathematics, Statistics and Computer Science

Judges:

Dr. Ellen Eckman, Associate Professor/Chair, Educational Policy and Leadership

Dr. John Pustejovsky, Associate Professor of German/Chair, Foreign Languages & Literatures

Dr. Ruth Ann Belknap, Associate Professor, College of Nursing

**2010**

Dr. Stephani Richards-Wilson

Assistant Dean for Recruitment and Retention, Klingler College of Arts and Sciences

Dr. M. Therese Lysaught

Associate Professor/Director of Graduate Studies, Theology

Dr. Lars Olson

Associate Professor, Biomedical Engineering

Dr. Sharon Chubbuck

Associate Professor, Educational Policy and Leadership

**2009**

*“The “Itinerant Museum”: Agrarian Reform, Peasant Revolt, and the Cultural Policy of Spain's Second Republic”*

Dr. Eugenia Afinoguenova

Associate Professor of Spanish, Foreign Languages and Literatures

*“Vamos Juntas: A pilot participatory action research project to assist Spanish speaking immigrant women in moderating life stressors”*

Dr. Ruth Ann Belknap

Associate Professor, College of Nursing

*“Muslim Outreach for Interfaith Dialogue: Al-Risala Movement’s Mission for the 21<sup>st</sup> Century”*

Dr. Irfan Omar

Associate Professor, Theology

*“Emergency dental care training for refugee health providers: An answer to dental care access in long-term refugee camps”*

Dr. Toni Roucka

Assistant Professor and Predoctoral Program Director of General Dentistry, General Dental Sciences

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# COLLOQUIES

## **Project Title: Daily Fluctuations in Psychosocial Factors and Glycemic Control in Adolescents with Type 1 Diabetes**

**Faculty Name:** Astrida Kaugars, Associate Professor, Psychology

**Student Name:** Natalie Benjamin

**Introduction:** Adolescents with type 1 diabetes (T1D) must work daily to monitor and maintain their blood glucose (BG) levels in order to achieve optimal glycemic control. Disease management requires adherence to an intensive treatment regimen that can be difficult and demanding for adolescents beginning to take responsibility for their own care (Garvey, Markowitz, & Laffel, 2012). Many psychosocial factors (including stress, negative affect, and self-regulation) impact BG levels, but they can be difficult to control and vary with daily demands. Thus, not only does adherence vary between youth, but individual adherence often changes significantly on a daily basis. Ecological momentary assessment (EMA) refers to a range of assessment methods that are naturalistic, ambulatory, and real-time. These include daily diaries and multiple daily assessments. These methods have many methodological advantages, including reduced recall errors and bias and increased ecological validity (Heron, Everhart, McHale, & Smyth, 2017). EMA is particularly relevant to research examining adherence behaviors in adolescents with T1D given the potential for daily fluctuations in individual characteristics and demands. Existing EMA research with adolescents with T1D has shown relationships between psychological factors and diabetes management (e.g., Lansing, Berg, Butner, & Wiebe, 2016). Furthermore, these methods highlight nuances in daily T1D management that are unaccounted for by one-time recall measures of glycemic control and psychosocial stressors.

**Significance:** The current study aims to assess the relationship between multiple daily factors known to affect adherence practices in adolescents with T1D and corresponding daily BG levels. Ecological momentary assessment will be conducted to assess the following variables: state anxiety, negative affect regarding diabetes, general and diabetes-specific stress, and self-regulation barriers to completing diabetes-related tasks. These data will be compared to participants' BG levels throughout the day. Relationships between BG values and self-reported variables will be explored. This study will be the first to explore daily fluctuations in both self-reported subjective variables and an objective physiological measure of glycemic control, and potential relationships between these two.

**Innovation/Forward Thinking:** Despite research establishing robust relationships between psychosocial functioning and glycemic control in this population, the daily interactions of affect, stress, self-regulation, and BG levels are still relatively unexplored, and further research is warranted to describe the complex relationships among these factors and determine predictors of optimal glycemic control. This study will use innovative methods (i.e., EMA) and analyses to determine associations between day-to-day changes in psychosocial functioning and adolescent diabetes management. This study will be the first of its kind to examine these relationships using an objective physiological measure of glycemic control (e.g., BG levels). Results will inform healthcare providers and caregivers about what factors contribute to optimal daily adherence, which is crucial for maintaining positive health-related outcomes in the long term.

**Student Involvement:** Natalie Benjamin, a clinical psychology graduate student, will carry out all research-related activities under the direct supervision and in collaboration with Dr. Astrida Kaugars. Ms. Benjamin will be responsible for all aspects of the study implementation, data collection, and result dissemination.

**References:** Garvey, K. C., Markowitz, J. T., & Laffel, L. M. (2012). Transition to adult care for youth with type 1 diabetes. *Current Diabetes Reports*, 12(5), 533-541. doi:10.1007/s11892-012-0311-6, Heron, K. E., Everhart, R. S., McHale, S. M., & Smyth, J. M. (2017). Using mobile technology-based ecological momentary assessment (EMA) methods with youth: A systematic review and recommendations. *Journal of Pediatric Psychology*, 42(10), 1087-1107, Lansing, A. H., Berg, C. A., Butner, J., & Wiebe, D. J. (2016). Self-control, daily negative affect, and blood glucose control in adolescents with type 1 diabetes. *Health Psychology*, 35(7), 643-651.

**Keywords:** Type 1 diabetes, Adolescent, Adherence, Daily fluctuations

**Project Title: Effective point-of-care (POC) molecular detection of malaria and schistosomiasis co-infection in pregnant women from two districts of Ghana**

**Faculty Name:** Nilanjan Lodh, Assistant Professor, Clinical Laboratory Science

**Student Name:** Brittany Pulkkila

**Introduction:** In sub-Saharan Africa, a significant proportion of the population is exposed to malaria, schistosomiasis and soil transmitted helminth infections (STHs: 1-3). Most importantly, about 40 million pregnant women are infected with these parasites [4], which is posing major public health problems in this region. When parasitic diseases overlap in distribution, high rates of co-infection occur [5]. Such is the case in Ghana; however, published data on the effect of helminth infections on pregnant women in Ghana is not extensive. Primigravidae (pregnant for the first time) women in malaria-endemic areas are more susceptible to infection from *Plasmodium falciparum* than when not pregnant, with consequences that include intrauterine growth retardation, low birth weight, pre-term delivery and neonatal mortality [6]. Yet, no study to date has assessed the prevalence of schistosomiasis and STH infections along with malaria in pregnant women and the impact of co-infection on the acquisition of immunity to placental malaria. This project seeks to fill this gap by determining the actual prevalence of co-infection vs. single infection with highly sensitive and specific point-of-care (POC) molecular test.

**Significance:** Standard diagnostic procedures such as rapid diagnostic tests (RDTs) for malaria, parasite egg detection in stool by Kato-Katz (KK: WHO recommended) for *Schistosoma mansoni* and urine filtration (detection eggs in urine) for *S. haematobium* lack sensitivity. The various culture methods for detecting *Strongyloides stercoralis* larva in stool lacks both sensitivity and specificity. As elimination campaigns progress, infections become less severe and present tests are often unable to detect light infections due to lack of sensitivity and specificity. The specific aims of this proposal are designed to address weaknesses in the current diagnostic techniques available for malaria, schistosomes and strongyloides by using POC loop-mediated isothermal amplification (LAMP) to determine the infection prevalence from a single non-invasive urine sample. LAMP assay for this study will be viable as repetitive DNA sequence detection for multiple parasites from a single urine sample is more sensitive and cost-effective than single copy gene detection for parasites from multiple samples.

**Innovation/Forward Thinking:** Our future aim involves the implementation of parasite-specific repeat DNA detection from urine both in the field and in clinics (via LAMP as a POC diagnosis) with a common sample preparation procedure for different endemic settings. To do that, first we have to demonstrate the efficacy and cost effectiveness of LAMP in detecting low intensity single and multiple parasite infection in field conditions. We will also demonstrate the role of low intensity infections in maintaining disease transmission. The population for this study is infected with multiple parasites and determining prevalence will be a major achievement for progress towards our future goal. The LAMP test will also be compared against "gold standard" (coprological and immunological) tests and calculations of sensitivity, specificity and diseases prevalence will provide feasibility and baseline data for future studies and for other groups to investigate urine samples. The stated study will be helpful for fostering collaboration with Ghana and expanding that relationship for future collaborative projects.

**Student Involvement:** Two undergraduate student research workers from the Department of Clinical Laboratory Science (CLS) will be involved in the project. They will be working on amplification of multiple species by LAMP, data collection, data analysis and scientific presentation of the study outcome in meetings and conferences. They are already working on other projects related to schistosomiasis.

**References:** 1. Brooker S, Akhwale W, Pullan R, Estambale B, Clarke SE, Snow RW, et al. Epidemiology of plasmodium-helminth co-infection in Africa: populations at risk, potential impact on anemia, and prospects for combining control. *The American journal of tropical m*, 2. de Silva NR, Brooker S, Hotez PJ, Montresor A, Engels D, Savioli L. Soil-transmitted helminth infections: updating the global picture. *Trends in parasitology*. 2003;19(12):547-51., 3. Snow RW, Guerra CA, Noor AM, Myint HY, Hay SI. The global distribution of clinical episodes of *Plasmodium falciparum* malaria. *Nature*. 2005;434(7030):214-7., 4. Getachew M, Tafess K, Zeynudin A, Yewhalaw D. Prevalence Soil Transmitted Helminthiasis and malaria co-infection among pregnant women and risk factors in Gilgel Gibe dam Area, Southwest Ethiopia. *BMC Research Notes*. 2013;6(1):263., 5. Petney TN, Andrews RH. Multiparasite communities in animals and humans: frequency, structure and pathogenic significance. *International journal for parasitology*. 1998;28(3):377-93. **Keywords:** Schistosomiasis, filtered urine, LAMP, molecular diagnosis

**Project Title: MSASPCP: Media Sentiment Augmented Stock Price Change Predictor****Faculty Name:** Praveen Madiraju, Associate Professor, Mathematics, Statistics, and Computer Science**Student Name:** Dawson d'Almeida, Joseph Coelho

**Introduction:** The stock market is a major indicator of the economy both nationally and internationally. Pricing of stocks depends on a variety of factors like industry performance, company news/performance, micro/macro economic factors, and investor confidence. Being able to predict the direction of the movement of a company's share price enables smart investing and provides stability in a volatile market. Various models that predict stock price changes rely on company news, market trends, historical data, etc. Studies have shown that stock market related discussions on social media platforms and news articles correlate to changes in the stock market. StockTwits is a twitter-like social media platform geared towards talk about on stock market related issues. In this study we use machine learning and natural language processing techniques on such textual data to predict stock market sentiment.

**Significance:** The stock market has a big impact on ordinary people. Most of the retirees in America have invested through their 401(k) savings in stocks to be able to live out their years. When stock prices fall they lose not only their earnings but also their peace of mind. Investing in stocks requires an ability to gauge market trends and having a tool that enables such forecasting is invaluable. The proposed solution involves a machine learning classification model based on StockTwits data augmented by sentiment analysis of news articles referenced by those Twits. The model is developed on the premise that StockTwits and stock market data are accessible in real time from the web using relevant APIs.

**Innovation/Forward Thinking:** The stock market is here to stay. Developing a strategic and accurate model to predict stock price changes is very relevant and useful. The model developed in the first iteration used Twits as a means to predict change (bullish or bearish) by identifying smart users, that is, users whose Twits corresponded to the change in market sentiment for the given date. In the second iteration, sentiment scores of news articles (URLs) referenced in the Twits were factored in. Sentiment analysis is a complex process. Studies have shown that generic sentiment analysis tools do not serve well in all domains. Developing a sentiment analysis tool catering to the stock market domain is another aspect of this project. The Loughram and McDonald word library is used to create a bag-of-words model to identify sentiment. The sentiment analysis tool can be further improved by including semantic analysis of the text. The accuracy of the model will be evaluated against the baseline prediction accuracy of the model of the first iteration.

**Student Involvement:** This work was started by undergraduate student Scott Coyne (2017) from Marquette University and carried forward by Dawson d'Almeida (2018) from Carleton College during their summer fellowships, with help from Joseph Coelho, a graduate student in MSCS, who also developed the sentiment analysis tool. The project is being executed under the direction of Dr. Praveen Madiraju, MSCS.

**References:** Bollen, J., Mao, H., & Zeng, X. (2011). Twitter mood predicts the stock market. *Journal of Computational Science*, 2(1):1-8., Sun, T., Wang, J., Zhang, P., Cao, Y., Liu, B., & Wang, D. (2017). Predicting stock price returns using microblog sentiment for Chinese stock market. *Proceedings of the 3rd International Conference on Big Data Computing and Communications*: 87-96.

**Project Title: Restaurant Recommendation using Social Media Analysis****Faculty Name:** Praveen Madiraju, Associate Professor, Mathematics, Statistics, and Computer Science**Student Name:** Paromita Nitu

**Introduction:** To keep pace with modern life style, almost 72% of Americans have reported an eating out preference for a quick meal to a full restaurant service (Jaaskelainen, Eating Out Behavior in the U.s.). With this rapid growth of eat out inclination, it is essential to provide suitable recommendations to the customers, since eating habits is such an individualized human behavior that members of same family can have significantly different food preferences. To accommodate user's unique food preference, an individualistic study based on social media user profiles can provide useful insight. Hence, in this project, we propose a personalized recommendation system, using user's social media profile - twitter data set. For example, looking at one's past tweets of user's family pictures (with kids), the system should intelligently recommend family friends restaurants.

**Significance:** In our study, we plan to train the model using users eat out preference features, such as food category, review, restaurant ambiance and as well as their life style features from the twitter data set. This personalized recommendation system uses location-based features such as geo tagged photos and status to incorporate location-based restaurant recommendation. The proposed prototype software should be (i) easy to use with just user's social media data (ii) able to provide user specific recommendation and (iii) prompt in response.

**Innovation/Forward Thinking:** To the best of our knowledge, there is no other personalized recommendation system that incorporates recency-bias weights to provide more scientific eat out preference recommendation. The recency-bias is designed to give more weight to most recent interests and gives less weight to older interests. Our model fits combination of social media profile information along with geo tag information to obtain appropriate restaurant recommendation. This project is still in its data collection phase. We are collecting twitter data and classifying the tweets as eat out preference tweets or not along with lifestyle tweets. We also plan to collect foursquare data. A survey on eat out preference options will help us evaluate the accuracy of the model.

**References:** Jaaskelainen, Liisa. Eating Out Behavior in the U.S. Retrieved from <https://www.statista.com/topics/1957/eating-out-behavior-in-the-us/>

**Project Title: The Removal of Estrogens using Electrochemical Technologies****Faculty Name:** Patrick McNamara, Assistant Professor, Construction and Environmental Engineering**Student Name:** Emily Maher

**Introduction:** Estrogenic compounds present a range of potential human and ecological health risks and have raised concerns regarding their impact on public health and the environment, and has driven the quest for improved removal technologies (Westerhoff, Yoon, Snyder, & Wert, 2005). This research investigated the impact of electrocoagulation on the removal of estrogenic compounds. Electrocoagulation generates coagulants in-situ and generates redox reactions that may remove estrogenic compounds from water. The influence of water quality parameters (pH, turbidity, and dissolved organic carbon [DOC]) and the mechanisms of removal for four estrogens - estrone (E1), 17-estradiol (E2), estriol (E3), and 17-ethynylestradiol (EE2) - were investigated using iron electrocoagulation. Electrocoagulation removed over 90% of all four estrogens, depending upon the system parameters. The greatest removal occurred at pH 9.5, and turbidity and DOC had an insignificant impact on estrogen removal. Adsorption accounted for a small fraction of the estrogens removal. While, quenchers in oxidant scavenger experiments indicated the presence of hydroxyl radicals and ferryl iron also contributed a small fraction.

**Significance:** A number of studies have shown estrogens are not well removed in conventional drinking water treatment (Westerhoff et al., 2005). As a result, people served by municipal drinking water treatment facilities are at risk of exposure to these contaminants and other EDCs. Estrogens and other EDCs make their way into drinking water via wastewater treatment plant outfalls and their subsequent occurrence in surface water; they have been detected in drinking, wastewater, and surface water (Benotti et al., 2009; Daughton & Ternes, 1999; Kolpin et al., 2002). The presence of estrogens has increased public concern, as well as heightened awareness of their ecological and human health impacts (Daughton & Ternes, 1999; Westerhoff et al., 2005). As a result novel technologies are needed, such as electrocoagulation, to remove estrogens from drinking water.

While EC is a promising technology to remove estrogens, to our knowledge, no research on the ability of iron EC to remove estrogens from drinking water has been completed. This research will assist in the future development of technologies capable of removing estrogenic contaminants.

**Innovation/Forward Thinking:** While EC is a promising technology to remove estrogens, to our knowledge, no research on the ability of iron EC to remove estrogens from drinking water has been completed. This research will assist in the future development of technologies capable of removing estrogenic contaminants.

**Student Involvement:** A doctoral candidate and an undergraduate research assistant conducted the laboratory work and literature review for this project.

**References:** The Removal of Estrogens using Electrochemical Technologies

**Keywords:** estrogens, drinking water, electrocoagulation, oxidation

**Project Title: Impact of the antimicrobial benzalkonium chloride on antibiotic resistance in a drinking water source**

**Faculty Name:** Patrick McNamara, Assistant Professor, Environmental Engineering

**Student Name:** Katherine Harrision

**Introduction:** Antimicrobials present in antibacterial soaps and detergents are valuable disinfection chemicals for consumers. However, triclosan, an antimicrobial, has been known to increase antibiotic resistance in the environment. Antibiotic resistance is a growing concern for public health and antibiotic resistance bacteria (ARB) contribute to 23,000 deaths annually in the United States costing an estimated \$1.0 billion in health care costs. Following consumer product usage, antimicrobials are washed down the drain and sent to wastewater treatment plants and later discharged into environmental waters that act as source waters for drinking water treatment plants. Many chemicals that end up in drinking water, including antibiotics and antimicrobials, can select for antibiotic resistance in the bacterial community. Due, in part, to triclosan's impact on increasing antibiotic resistance and formal ban in 2016 by the Environmental Protection Agency (EPA), a new ingredient, benzalkonium chloride (BAC), has widely replaced it in antibacterial soaps. However, little is known about the impact of BAC on antibiotic resistance.

**Significance:** The purpose of this study was to determine the effect of BAC on the relative abundance of ARB and antibiotic resistance genes (ARGs) in a surface water used for drinking water. Since little is known about the impact of the antimicrobial BAC on antibiotic resistance, there are potential concerns that BAC will select for antibiotic resistance. Increasing concentrations of BAC relevant to the environment, ranging from 0 to 500 were added to water microcosms and mixed for 14 days. Direct plating with 9 antibiotics was used to determine phenotypic antibiotic resistance. Quantitative PCR was performed to determine the impact of BAC on the relative abundance of three ARGs and the *intI1* gene. This research establishes the impact of BAC on selection for antibiotic resistance in a source water used for drinking water and suggests that BAC contributes to the dissemination of antibiotic resistance in a source water for drinking water.

**Innovation/Forward Thinking:** This research will increase the understanding of the role antimicrobials play in engineered systems and the potential health impacts they pose in the environment. Furthermore, a study of this capacity to determine the impact of BAC on antibiotic resistance in source water has never been done before. Results from this research will be prepared for a manuscript as they suggest that BAC contributes to the dissemination of antibiotic resistance in a source water for drinking water. This study will be crucial in discerning if BAC will continue to remain unregulated by the EPA or if the potential health risks are too great to ignore in everyday consumer products.

**Student Involvement:** An undergraduate student, Katherine Harrison, is a senior at Marquette University and developed objectives, hypotheses, and overarching research plans to complete the research through a semester-long independent study taught by Dr. Patrick McNamara. Additionally, Katherine has trained an undergraduate student in the methods she developed while working with a postdoctoral researcher in the Water Quality Center in Engineering Hall.

**References:** M. T. E. Suller, A. D. Russell; Triclosan and antibiotic resistance in *Staphylococcus aureus*, *Journal of Antimicrobial Chemotherapy*, Volume 46, Issue 1, 1 July 2000, Pages 11–18., Centers for Disease Control and Prevention. Antibiotic resistance threats in the United States; 2013.

**Keywords:** antibiotic resistance, drinking water distribution system, antimicrobials, benzalkonium chloride

## **Project Title: "Motivational Interviewing as a Technique to Reduce Vaccine Refusal and Hesitancy Among Parents"**

**Faculty Name:** Linnea Nagel, Clinical Assistant Professor, Physician Assistant Studies

**Student Name:** Megan Jacobson, Taylor Shuster, James Waller

**Introduction:** Today, vaccine hesitancy is no unique dilemma to the public and health care system. Since the invention of vaccinations in the 18th century, apprehension towards vaccinations has been observed (Succi, 2018). As laboratory technology is continuously advancing, vaccinations are at a higher standard of safety and efficacy, however reluctance is still among us. This reluctance threatens herd immunity, the concept that if a certain number of people are vaccinated, a resistant population can be maintained, and outbreaks can be prevented. For example, measles, which is part of the MMR vaccine, requires roughly 95% herd immunity (Haire, 2018). Events such as the 2015 Disney World Measles outbreak which resulted in a total of 147 confirmed measles cases has shown that vaccine coverage for certain diseases has declined and deficits in proper herd immunity are currently a problem (Blumberg, 2015). Today, in certain communities, vaccination rates have decreased to where herd immunity is threatened. In Wisconsin for the 2009-2010 school year, 91% of students in Wisconsin met school requirements for vaccinations, while 72% of students in Milwaukee Public Schools met the requirements. Since 2010, vaccination rates in Wisconsin have increased, but are still not to herd immunity standards (Milwaukee Health Department, 2018).

**Significance:** As future health care providers we continuously strive for the best interest of our patients. With vaccination rates on the decline, we are concerned about overall public safety, the concept of vaccination is critical.

**Innovation/Forward Thinking:** Discussion with hesitant parents on vaccines in the clinical setting has been difficult for many providers as some patients/parents can have firm beliefs. Thus, our main objective with our project is to improve vaccination rates by welcoming open conversation and developing patient/provider relationships. Our approach will be supported through a technique defined as motivational interviewing (MI). MI is an established approach in other aspects of healthcare, but new to the discussion of vaccinations. MI identifies the individual's internal motivation to change and assists the provider to guide the patient into discovering the inconsistency of the current behavior (Center for Substance Abuse Treatment, 1999). This in turn will allow for self-change of the behavior of patients/parents. We hope to find with this strategy that differing opinions do not cause discourse but allow for understanding and open conversation in a way that does not lead to inhibition. For vaccinations, the ultimate decision is unquestionably the patient's/parent's. However, we want to ensure the individual has all resources available to make the best decision for themselves.

**Student Involvement:** As third year graduate students in the Marquette University Physician Assistant Studies Program, direct patient contact and care is a daily occurrence. As we are establishing relationships with our patients, we must be prepared for many difficult conversations, such as disease diagnosis, death, etc. In our curriculum, vaccination resistance was discussed although not with using motivational interviewing to direct the conversation. Through this project, we strive to become better equipped clinicians to discuss concerns about vaccinations in the healthcare communities where we will soon practice.

**References:** 1. Blumberg, S., Worden, L., Enanoria, W., & et al. (2015). Assessing measles transmission in the United States following a large outbreak in California. *PLoS Currents*. 7. doi: 10.1371/currents.outbreaks.b497624d7043b1aecfbfd3dfda3e344a.,  
2. Center for Substance Abuse Treatment. (1999). Enhancing motivation for change in substance abuse treatment. (Treatment improvement protocol (TIP) series, No. 35.) chapter 3-motivational interviewing as a counseling style.,  
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**Keywords:** disease, vaccination, motivational-interviewing, herd-immunity

# **INTERNATIONAL POSTER ABSTRACTS**

**Project Title: Cardiovascular Risk Assessment using Pulse Wave Velocity (PWV) analyzed by Photoplethysmography (PPG) generated from a video captured by a Smart Phone**

**Faculty Name:** Sheikh Iqbal Ahamed, Professor, Mathematics, Statistics and Computer Science  
Richard Love, Professor, Mathematics, Statistics and Computer Science

**Student Name:** Md Hasanul Aziz, Md Kamrul Hasan

**Introduction:** With increasing age, as a consequence of multiple risk factors, arterial vessels become less compliant and stiffer, a process called arteriosclerosis, which circumstances are associated with increases in blood pressure and other adverse vascular clinical events. Arterial stiffness (AS) involves the entire thickness of the arterial wall which can tell us the apparent age of the arteries, which in turn tells us how well is performing our cardiovascular system. To measure AS, we can use Pulse Wave Velocity (PWV) where PWV is the velocity at which the blood pressure pulse propagates through the circulatory system [IM02]. Fig.1 represents how PWV increases with the increase of AS.

**Significance:** The emerging emphasis on AS has come about because of its relevance to the entire vascular system. It is increasingly considered that AS may be a better marker of risk and a more relevant endpoint for cardiovascular events and mortality than currently available indicators. The current gold standard for non-invasive PWV measurement is the Carotid-Femoral Pulse Wave Velocity (cfPWV) system which measures carotid and femoral pulse waves from PPG signals and EKG inputs, and calculates the time delay because of the different distance of the two vascular sites from the heart (fig.2). Commercially available systems for measuring PWV are complex to use, expensive and do not provide well-standardized results. So, it will be immensely helpful for everyone if we can find a user-friendly inexpensive method to measure PWV.

**Innovation/Forward Thinking:** Currently, lots of research is going on to extract PPG signal from a fingertip video captured by a smart-phone. But, we have to capture PPG signal from two vascular points having minimal distance and ECG signal at the same time. At first, we will place electrodes on the chest and connect them to the earphone jack. After that, we will capture two fingertip video from two vascular points separately. From two videos we will generate two sets of ECG and PPG signal by processing audio and image of the videos. While capturing the videos we will also collect the gold standard value of PWV. From all the data, we will build a model using different machine learning techniques to calculate PWV. We will also make a mobile application to provide all the instructions and capture the video.

**Student Involvement:** At first, the students will make a prototype to collect data. Then they will build the model based on the data.

**References:** [IM02] J.R. Cockcroft I.S. Mackenzie, I.B. Wilkinson, Assessment of arterial stiffness in clinical practice, QJM: An International Journal of Medicine 95(2002), 67–74. [MB12]

**Project Title: Mediation in the Normal Chaos of Family Law: A Cross National Comparison****Faculty Name:** Alexandra Crampton, Associate Professor, Social and Cultural Sciences

**Introduction:** Mediation in family court was first developed during the 1980s in the United States to help resolve child custody disputes during divorce. In the predominant model, the mediator is a neutral facilitator who helps parties to identify their interests, resolve differences, and reach an amicable agreement. By the early 1990s, mediation had spread not only across family courts in the U.S. but around the world. Today, family courts rely on mediation to resolve parenting conflicts in cases filed during divorce, post-divorce, and post separation of never married parents. While a policy and professional consensus identifies benefits, ongoing research into cases of high conflict between parents raises concern that more reform is needed. Over time, Australia has become the world leader in family law reform, seeking innovative ways to encourage and support post separation parenting. Major reform in 2006 brought child custody cases out of court and into 65 Family Relationship Centres (FRC) around the country. Yet, professionals and policy makers continue to review and reform given a persistence of "high conflict" cases that keep coming back to court. This study will examine why from a parent perspective.

**Significance:** There is ongoing debate about why conflict persists in parenting dispute mediation cases, whether mandatory policies ought to be amended, and how use of mediation and similar services can be improved. Most has been conducted from a policy and professional perspective, identifying through court records and survey data whether mediation through court and FRCs reduces hostility and improves parenting relationships. My anthropological work, however, shifts focus from the professional perspective to the parent perspective by closely following parents as they engage in mediation services and are invited to speak candidly in post-mediation interviews (Crampton 2016). In previous research on the Milwaukee County Family Court Mediation Service, I found that a key complication is the "chaos of family law" (Dewar 1998). That is, parenting conflicts are difficult to resolve due to larger personal contexts of chaos in raising families and navigating relationship loss such as divorce. As Dewar explains, family law cannot be constructed to offer clear rules over this chaos in societies that also value self-determination and individual case discretion by professionals. While social scientists may try to narrow chaos into objective terms, allowing the subjectivity and complexity of chaos as research data has helped me to explain to policymakers and practitioners why parents may not respond to their interventions as intended. Given the extent of family law reform in Australia, I began replication of my U.S. study last summer through preliminary research in two FRCs. I also met key researchers in Australian family law reform. Dr. Bruce Smyth has invited collaboration. He has conducted extensive family law reform research as a demographer with special attention to parenting conflicts (e.g. Smyth et. al. 2014). We will next meet in December to help integrate his sociological survey research approach with my anthropological approach as part of this proposed project.

**Innovation/Forward Thinking:** The U.S. was once a leader in family law reform, and yet the major reforms taking place in the past two decades have been in Australia. International comparison from a parent perspective will not only help identify what is working but will also help identify the benefits and limits of ongoing reform. The Milwaukee County study allowed examination of mediation through court-based services on a tight budget. An Australian comparison would offer the other extreme through research in a comparatively well-funded program run by community-based services. There may be lessons to bring back to the U.S. as well as insight into the limits of reform given the previously mentioned tensions among family law intervention, personal self-determination, and professional case discretion. Funds are needed to move from last summer's preliminary research to active data collection this summer.

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**Keywords:** Family Law, Child Custody Disputes, Mediation, cross-national comparison

**Project Title: Understanding Public Harassment Experiences on Social Media in Bangladesh****Faculty Name:** Shion Guha, Assistant Professor, Mathematics, Statistics, and Computer Science**Student Name:** Fayika Nova

**Introduction:** The freedom to move around and go anywhere in public is one of the most fundamental civil rights of an individual [49]. But sometimes, this basic right becomes a fantasy to some people who face public harassment on the street, in public transportation or other public places that restricts their public participation. Although researchers are studying this pervasive issue considering both developed and developing context in mind, the issue of harassment tends to be more prevalent in developing nations [71]. Public harassment can include a wide range of negative behaviors such as sexual harassment, leering, unwelcome comments, whistling, barking, or kissing noises, following or blocking path and so on [37]. Social media plays a big role on how these experiences of public harassment are shared with others. Sharing harassing experiences on social media can produce both positive and negative feedbacks from the readers, including formal law authorities, that may or may not comply with the victim's expectations of sharing [1, 29, 38]. This phenomenon of sharing experiences with specific expectations on social media varies from person to person and from context to context, and that's why in our study, we have decided to focus on this issue more deeply in the context of Bangladesh, a developing country, where focus on both victims' and law officials' perspectives related to this issue has been understudied.

**Significance:** Through our study, we mainly seek answers to the questions of underlying reasons behind sharing experiences of harassment on social media and the construction of socio-cultural and religious bias, and tension between Law Enforcement Agents (LEAs) and the victims that follow through. For our study, we follow a mixed methods approach that includes anonymous online survey and semi-structured interviews. The interviews include both the victims of public harassment and participants from Bangladesh's justice system who have experiences on this regard.

**Innovation/Forward Thinking:** Our study contributes to the existing literature through investigating public harassment on the context of developing nation that unlocks many unspoken biases, infrastructural weaknesses, tension between the victim and LEAs and behavioral trend that can be observed on social media. We will also instigate that, whether due to lack of proper policy, literacy, accountability and moreover, a proper framework in Bangladesh on social media, the LEAs are able to handle their responsibilities or not, which may deflect many victims from receiving justice on these platforms. We believe this study opens up many doors for future research on the field of public harassment in a developing country where there exist many contextual bias and norms that can be observed through the activities on different social media.

**Student Involvement:** Doing the literature review, designing the survey and interviews, conducting those, monitoring field researchers for data collection, designing the whole paper and writing it.

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**Keywords:** Public Harassment, Social Media, Social Support, Social Justice

**Project Title: Does teaching strategy matter? Students perception and satisfaction from different Dental programs**

**Faculty Name:** Mohamed Ibrahim, Assistant Professor, School of Dentistry- Surgical Sciences

Noha El Wassefy, Associate Professor, Dental Biomaterials

**Student Name:** Jordan Johnson

**Introduction:** Dental education is regarded as a unique, complex and sometimes stressful procedure. Teaching strategies refer to methods used to help students learn the desired course contents and be able to develop achievable goals in the future. As education is not a one size fits all, implementing one teaching methods may be suitable for some students and others may struggle and need a modification to help them achieve their learning outcomes. In Mansoura university, Egypt, Faculty of Dentistry has a traditional dental program (MTDP) that graduates about 500-600 dentist per year. It is a five years program that is based on lectures, practical, and clinical sessions. Recently in 2017, Mansoura Faculty of Dentistry started a new student-centered program, implemented from Manchester Dental school in England. It is founded on Enquiry based Learning approach (EBL), that allows the students to work together in small groups (9-12 students per group) with an intention to improve their communication and listening skills under the supervision of an academic facilitator or tutor. Mansoura Manchester Dental program (MMDP) integrates basic and applied science at the same level with an early induction into dental clinics, it also focuses on improving students' personal skills as well as professionalism. The clinical curriculum of the Marquette University Dental program (MUDP) is based on a general practice model. The philosophy of this model is to provide quality comprehensive dental care without fragmentation into separate specialties or disciplines. Students learn to focus on the patient's total dental needs rather than a single clinical procedure. The program that applies this philosophy is the Comprehensive Patient Care Program. The massive disparity between these programs requires some validating research to measure and compare student's perception and satisfaction.

**Aim of Study:** This study aims to investigate perception and satisfaction as perceived by learners from MTDP and MMDP and compare it to Marquette University Dental Program (MUDP) applying comprehensive care model teaching strategy.

**Methodology:** Sophomore students of these programs will be asked to answer same questions in a web-based survey. The online questionnaire will be posted through the Facebook group of undergraduate dental students from all dental programs. The theoretical base of the survey is modified from the five-step model for interactivity by (Salmon, 2004) and based on the following items; 5 items measuring the students engagement and involvement within both programs; 6 items questioning the program structure influence on the students; 17 items concerned about the program learning experience; and finally 8 items regarding the methods of assessments. Data will be collected from students, then statistically analyzed.

**Significance:** Identify pros and cons of each teaching methodology and making recommendations to improve it based on students perception and satisfaction

**Innovation/Forward Thinking:** The massive disparity between these programs requires some validating research to measure and compare student's perception and satisfaction to improve the learning outcomes

**References:** Salmon G. E-moderating: The Key to Teaching and Learning Online. Psychology Press; 2004, Herman H. Loyalty, Trust, Satisfaction and Participation in Universitas Terbuka Ambiance: Students' Perception. Turkish Online Journal of Distance Education. 2017; 84–84., Kim MJ. Students' Satisfaction and Perception of Problem Based Learning Evaluated by Questionnaire. Kosin Medical Journal. 2015;30: 149., Carmona IT, Palas J. Spanish dental students' perception of the "educational climate." Med Teach. 2012;35: 260–261., Anderson V, Reid K. Students' perception of a problem-based learning scenario in dental nurse education. Eur J Dent Educ. 2012;16: 218–223.

**Project Title: Successful Re-entry: A study of Formerly Incarcerated Offenders in Finland****Faculty Name:** Richard Jones, Professor, Social and Cultural Sciences**Student Name:** Amber Zander

**Introduction:** This is an exploratory study of the experiences of formerly incarcerated persons who have successfully re-entered society in Finland. The research builds on prior research on the problems faced by ex-prisoners as they attempt to overcome the odds of making it in the free world. The purpose of the research is to examine how ex-prisoners defined re-entry challenges and developed strategies to address these problems.

**Significance:** Experiencing prison carries numerous direct and indirect consequences. Richards and Jones, 1997, identified a variety of structural impediments to post-prison success which ultimately leads to a perpetual incarceration machine. Four structural problems associated with re-entry are employment concerns, housing concerns, family troubles and various legal restrictions. In addition, ex-offenders must also cope with various psychological and emotional issues, including drug and alcohol problems, anger and frustration over their incarceration as well as having to face the structural problems associated with re-entry. Early findings from this project indicate that generous social service and the humane treatment of offenders play an important role in producing low recidivism rates in Finland. Secondly, successful re-entry is accomplished through the development of a coherent pro-social identity for themselves. This is consistent with Maruna's claim that what ex-offenders need is a new perspective on life. This may entail a revision of aspirations and/or an increasing concern for others.

Finland made a decision to turn away from correctional policies heavily influenced by the former Soviet Union to a philosophy which Ekunwe (2005) refers to as "Gentle Justice." Embodied in this philosophy is a concern for the citizen (including criminals and prisoners), thereby maintaining many of the rights of citizenship for Finnish prisoners, while also insuring a range of rehabilitative programming and re-entry services (the principle of normality). As a result, every effort is made to reduce the negative impacts of incarceration as possible. Finland, along with other Nordic countries, have the lowest recidivism rates in the developed world (around 35%).

**Innovation/Forward Thinking:** This study of re-entry in Finland began with interviews conducted during a study abroad course in Finland in May 2018 and continued during Jones' sabbatical at Tampere University in Finland. Further interview data will be collected in May/June 2019 in Helsinki.

**Student Involvement:** Amber Zander has been involved in data collection, analysis of data and writing the proposal.

**References:** Ekunwe I. 2007. *Gentle Justice: Analysis of Open Prison Systems in Finland: A Way to The Future?* Tampere, Finland: Tampere University Press.,

Lappi-Seppala, Tapio. 2001. "Sentencing and Punishment in Finland: The Decline of the Repressive Ideal," pp. 139-162 in Tonry, M. and Frase, S. (eds.), *Sentencing and Sanctions in Western Countries*. New York: Oxford University Press.,

Littunen, Jarmo. 2010. "Using Criminological Research in Policy Planning." Key note address at the conference on *Global Perspectives on Re-entry*. Tampere, Finland: University of Tampere.,

Maruna, Shadd. 2001. *Making Good: How Ex-Convicts Reform and Rebuild Their Lives*. Washington, D.C.: American Psychological Association.,

Richards, Stephen C., and Richard S. Jones. 1997. "Perpetual Incarceration Machine: Structural Impediments to Post-Prison Success." *Journal of Contemporary Criminal Justice* 13 (1): 4-22.

**Keywords:** Re-entry, Recidivism, Incarceration, Rehabilitation

**Project Title: Fostering Resilience Among Latvian Adolescents: Examining the Influence of Youth Education Groups on Adolescent Relationships**

**Faculty Name:** Astrida Kaugars, Associate Professor, Psychology

**Student Name:** Jamee Carroll

**Introduction:** The current sociopolitical situation in Latvia poses challenges for adolescents developing healthy relationships. Close attachment relationships and positive views of the self are factors that promote resilience (Masten, 2018). Yet, child rearing attitudes among parents in post-Communist Latvia (Sebre et al., 2004) and dominant views of gender equality and gender stereotypes impact the nature of adolescent family, peer, and romantic relationships. Masten (2014) called for global research on resilience to not only enhance the existing knowledge base but also to contribute to informing interventions in different sociocultural contexts.

**Significance:** Latvia is one of eight European Union (EU) member states that does not have a comprehensive national system to support victims of violence and domestic abuse. A 2016 survey of EU citizens found that 64% of Latvians viewed abuse of women in families as unacceptable; the average figure among EU citizens was 84%. A 2017 World Health Organization report estimated that on average individuals in Latvia (15 yrs+) consume 12.3 liters of pure alcohol within a calendar year. 2015 legislation significantly limited education in schools on healthy emotional, physical, and sexual relationships. Thus, Latvian adolescents are growing up in a cultural context with few models of and education on how to develop and sustain healthy relationships. MARTA Centre is a Latvian non-governmental organization that provides support to women. For the past eight years MARTA has offered youth programs to raise awareness of gender stereotypes and to support youth in developing healthy relationships with peers, parents, and teachers. In 2018 MARTA has been piloting a new curriculum with five youth groups in Latvia (50 adolescents, 13–17 yrs old). Participants meet for 16 two-hour sessions with a trained facilitator. The curriculum aims to reduce violence among adolescents by helping them develop and maintain non-violent, respectful, and safe relationships.

**Innovation/Forward Thinking:** There is a dearth of information documenting Latvian adolescent perceptions of relationships and how those may be modified by a youth education program. This study will investigate the impact of Latvian youth education groups from the perspectives of the participants, the leaders, and participants' friends, family members, and teachers. Expanding inquiry to participants' peers, family members, and teachers will allow exploration of how the program impacts the participants' close relationships. Have there been changes in the participant's thinking and behavior due to his/her participation in the youth education program? A second aim of the study is to provide additional documentation for the need for youth education groups in Latvia. Interviews with youth education group leaders will document their perceptions of challenges facing youth in developing healthy relationships.

**Keywords:** adolescents, resilience, education, international

**Project Title: Examination of Vibrotactile Feedback application site for guided reaching in survivors of stroke**

**Faculty Name:** Robert Scheidt, Professor, Biomedical Engineering

Maura Casadio, Associate Professor, Biomedical Engineering, University of Genoa, Italy

Leigh Ann Mrotek, Research Professor, Biomedical Engineering

**Student Name:** Ashiya Thomas

**Introduction:** We are developing a vibrotactile feedback (VTF) device that will provide supplemental movement feedback to survivors of stroke, to improve upper extremity movement accuracy. Stroke affects 795,000 people per year in the US (Benjamin, et al., 2017) and impacts many aspects of brain function, including proprioception (sense of one's own body), and movement control. Of the those afflicted with stroke, about 25% retain muscle strength but have proprioceptive loss (Carrey et al., 2011). These survivors have difficulty moving accurately (Scheidt and Stoeckmann, 2007).

**Significance:** Proprioceptive deficits contribute to decreased performance of skills (e.g., dressing oneself, cooking, eating) that are essential to the activities of daily living needed to live alone in one's own home (Tyson et al., 2008). We expect that survivors of stroke with impaired proprioception will be able to regain lost skills when VTF provides movements information. Determining the best application site to provide VTF will advance development of this new assistive technology.

**Innovation/Forward Thinking:** This project is the next logical step in ongoing research in our laboratory to determine how VTF will be provided to survivors of stroke to improve movement smoothness and accuracy. I have tested three survivors and found that the ability to interpret VTF to guide movement varied widely by person and application site. However, this is a small sample of a heterogenous population and needs to be tested in a larger group to determine the best location for applying VTF for each individual, and/or to determine if there is a consistent best site across individuals.

**Student Involvement:** From now until May, I will continue pilot testing survivors of stroke at MU to refine our experimental methods. I will travel to Italy to collect data on survivors of stroke and to be mentored by Dr. Maura Casadio at the University of Genova (UniGE). Dr. Casadio has developed a portable device for measuring 2D planar movements that could be incorporated with our technology for providing VTF training. There they have access to many survivors of stroke in their affiliated clinics. Survivors will be recruited from Ospedale Policlinico San Martino in Genova\*. While in Italy, I will collect data from 15 survivors and 15 age-range matched control participants. Upon my return, I will continue working with all my mentors to analyze data and produce a manuscript.

**References:** Benjamin E.J., Blaha M.J., Chiuve S.E., Cushman M., Das S.R., Deo R., Ferranti S.D., Floyd J., Fornage M., Gillespie C., et al. (2017). On behalf of the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease, Carey, L., Macdonell, R., & Matyas, T. A. (2011). SENSE: Study of the Effectiveness of Neurorehabilitation on Sensation. *Neurorehabilitation and Neural Repair*. 25(4), 304-313., Scheidt RA, Stoeckmann T. (2007). Reach adaptation and final position control amid environmental uncertainty following stroke. *J Neurophysiol*. 97:2824–2836., Tyson SF, Hanley M, Chillala J, Selley AB, Tallis RC. (2008) Sensory loss in hospital-admitted people with stroke: characteristics, associated factors, and relationship with function. *Neurorehabil Neural Repair*. 22:166–172.

**Keywords:** Stroke, Proprioception, Vibrotactile Feedback, Arm Movement

**Project Title: Crossing visionary boundaries: A cross-cultural photovoice research project on race and markets**

**Faculty Name:** Kevin Thomas, Assistant Professor, Strategic Communication

**Student Name:** Yin Yang

**Introduction:** Racial dynamic remains central to contemporary marketing strategies across the globe, including product development, consumer segmentation, advertising and marketing communication approaches, online and offline service delivery, and pricing policies. Despite its continued centrality to market activities, there is a paucity of that critically examines the relationship between race and markets beyond the U.S. This study employs a cross-cultural mode of inquiry, wherein the predominately multiculturalist sensibilities of US racial dynamics are contrasted with the largely assimilationist approach in France. The aim of this study is to understand how differing conceptions of race impact, and have been impacted by, market relations, which may enable scholars, scholar-activists and advocates to more effectively address complexities and nuances associated with racial privilege, power and vulnerabilities during the current global proliferation of neoliberal market logic.

**Significance:** This project draws on critical race theory (CRT) for its theoretical framework. Rarely used in consumer research, CRT posits that white supremacy and racial power are maintained over time (Delgado & Stefancic, 2017). However, rather than focus on the role that law plays in the maintenance of racial power, as is typically done with traditional CRT research, in this project we center our attention on the ways in which markets and consumption practices are built upon and support racial hierarchies (Davis, 2018). As a critical research approach, CRT is often enacted in unison with participatory research methodologies. In the present research we incorporate photovoice, which provides a process by which people can "identify, represent, and enhance their community through a specific photographic technique" (Wang & Burris, 1997, p. 369). Using photography, photovoice prompts individuals to visually capture representations of their everyday lives.

**Innovation/Forward Thinking:** This study seeks to uncover how, if at all, a society's overarching cultural orientation impacts the ways in which race is expressed and experiences in marketplaces. Data collection will occur in two phases. Phase 1 includes gathering and analyzing current (last three years) examples of print advertisements from a broad cross-section of popular publications from the U.S. and France. Analysis of the advertisements will be done using the approach of critical discourse analysis. This approach argues that discourses are shaped by context, and conversely that discourses influence political and social reality (van Leeuwen & Wodak, 1999). Phase 2 involves conducting ten depth interviews with advertising practitioners in the U.S. and France. Using an phenomenological interviewing approach, the purpose of Phase 2 is to gather insights into how race is conceptualized and mobilized as a marketing communication tactic. In addition, this project will further formalize the structure and research agenda of the Race in the Marketplace (RIM) Research Network, of which Dr. Thomas is a founding member and co-organizer. (International Component: This project broadens the examination of the relationships between race and markets beyond the United States. We contrast the market relations between U.S. and France, which are influenced by different racial ideology. Furthermore, the study will benefit a new international organization – RIM, whose focus is on the promotion of racial diversity in marketplaces.)

**Student Involvement:** Master student Yin Yang is currently working on the literature review, and will be instrumented with data analysis, and write up.

**References:** Davis, J. F. (2018). Selling whiteness? – A critical review of the literature on marketing and racism. *Journal of Marketing Management*, 34(1/2), 134-177.,  
Delgado, R., & Stefancic, J. (2017). *Critical Race Theory: An Introduction*. New York, New York: NYU Press.,  
Wang, C., & Burris, M.A. (1997). Photovoice: Concept, methodology, and use for participatory needs assessment. *Health education & behavior*, 24(3), 369-387.,  
van Leeuwen, Theo., & Ruth Wodak. (1999). Legitimizing immigration control: A discourse-historical analysis. *Discourse Studies*, 1(1), 83–118.

**Keywords:** cross-cultural, race, markets, discourse analysis

# **FORWARD THINKING POSTER ABSTRACTS**

**Project Title: Deep Learning Methods to Reduce Energy Consumption in Datacenters**

**Faculty Name:** Cristinel Ababei, Assistant Professor, Electrical and Computer Engineering

**Student Name:** Wenkai Guan

**Introduction:** Datacenter electricity consumption is projected to increase to 140 billion kilowatt-hours annually by 2020, costing American businesses \$13 billion per year in electricity bills and causing the emission of nearly 150 million metric tons of carbon pollution annually. Improving the efficiency of datacenters or warehouse scale computers (WSCs) has been identified as one of the top priorities of web-service companies as it improves the overall total cost of ownership of WSCs. Therefore, this project develops new dynamic power management methods to reduce energy consumption in datacenters.

**Significance:** The research question that this work will answer is: can deep machine learning techniques be leveraged to create significantly better methods for power and performance optimization in heterogeneous multicores and datacenters? If so, the potential energy savings can have a significant impact on the cost of operation of the datacenters and thereby on the cost of a vast number of web-services used in virtually all aspects of society.

**Innovation/Forward Thinking:** The proposed solution explores deep learning techniques based on deep neural networks (DNNs) to capture application behavior and its relation to different heterogeneous server platforms and to provide mechanisms to exploit that for better energy optimizations. New adaptive job scheduling algorithms will be developed whose objective is to reduce overall energy consumption in a manner that minimizes interference and maximizes server utilization.

**Project Title: Prediction of potential soft-tissue injuries by player load for basketball athletes****Faculty Name:** Sheikh Ahamed, Professor, Mathematics, Statistics and Computer Science**Student Name:** Jiachen Ma

**Introduction:** Contusions and muscle strains are the most common injuries in contact sports. Young basketball athletes tend to sustain more soft-tissue injuries to their lower extremities. The major goal of this project is to reveal the relationship between player load (PL), and soft tissue injuries on basketball athlete's extremities. Based on previous research, heavy training workloads may result in overuse injuries [1]. However, little is known regarding what role PL plays in the cause of contusions and muscle strains. Meanwhile It has also been demonstrated that wearable sensors are capable of analyzing the impact of basketball training [2]. Therefore, we propose a more advanced multi-sensory approach to capture accurate PL distribution for further investigation.

This project also aims at predicting and preventing injuries during basketball training sessions. We will apply supervised machine learning algorithms to PL data from multiple body positions with muscle ache scores after basketball training sessions. By feeding real-time PL to the PL-Ache model, we hope to produce a predictive model for contusions or muscle strains in basketball athletes. Goal will be to avoid such injuries by recommending modifying basketball training methodology.

**Significance:** Recent research has shown that PL is sensitive to vibrations [3], which indicates that PL could be used as an indicator of small unnoticeable collisions accumulated in contact sport. In general, small collisions contribute to soft-tissue injuries on lower extremity positions such as ankle and knee are hard to monitored. However, if we separate vibrations from PL, unnoticeable collisions can be computed instead of measured directly. But whether these injuries can be reflected by PL is still unclear, thus we need to examine and reveal the relationship between PL with soft-tissue injuries. If it is positive, then we may get a new way of detecting unnoticeable collisions in contact sport. It is also the first time associating PL with soft-tissue injures in contact sports. As far as we know, most studies have focused on rugby or running. It is a good opportunity for us to may make a significant impact on basketball training methodology. By applying the latest wearable techniques, we hope to improve athletes' performance as well as protect their health.

**Innovation/Forward Thinking:** This project introduces an innovative approach to calculate player load (PL) from multiple accelerometer sensors. Most research only uses a sensor attached on the center of mass (COM), which is usually located on the upper back of the athletes. This approach however combines individual extremity's PL with PL from COM. Four MinimaxX sensors will be employed, on athlete's wrist and ankle positions to capture acceleration on lower and upper limbs, and one additional MinimaxX sensor will be put between athlete's scapula to record acceleration on COM position. Instead of using COM PL, we take several individual PLs into consideration. This enable us to capture a more accurate PL distribution on athlete. Most research also only employs standard regression models on PL analysis, this proposal will combine the latest data processing technology with PL. With the help of deep learning, we can build new data analytics models that link PL distribution with soft-tissue injures.

**Student Involvement:** Initial thought, developing low cost sensors, collecting and analyzing data

**References:** Brenner, J. S. (2007). Overuse injuries, overtraining, and burnout in child and adolescent athletes. *Pediatrics*, 119(6), 1242-1245.,

Schelling, X., & Torres, L. (2016). Accelerometer load profiles for basketball-specific drills in elite players. *Journal of sports science & medicine*, 15(4), 585.,

Hollville, E., Couturier, A., Guilhem, G., & Rabita, G. (2016, May). MinimaxX player load as an index of the center of mass displacement? A validation study. In *ISBS-Conference Proceedings Archive* (Vol. 33, No. 1).

**Keywords:** Player Load, Injuries, Athlete Health, Basketball

## **Project Title: Multi-parameter Intelligent Sepsis Prediction in the Intensive Care Unit: Unpacking Contextual and Machine Learning Challenges**

**Faculty Name:** Sheikh Iqbal Ahamed, Professor, Mathematics, Statistics, and Computer Science

**Student Name:** Devansh Saxena, Nazmus Sakib

**Introduction:** Algorithms are being developed using Electronic Medical Records (EMRs) that predict the development and onset of diseases. However, most of these algorithms are not deployable in any practical clinical setting because the training process of these algorithms does not account for medical interventions that confound and censor the true outcome of an illness in the absence of such interventions [1]. In this proposed study, we focus our attention on the entire timeline of a disease and the ongoing medical interventions and seek to develop a time series Change Point Detection algorithm for sepsis and mortality prediction.

**Significance:** We are working towards developing a time series Change Point Detection algorithm for sepsis that accounts for the temporality of the clinical data by observing the longitudinal waveform data and also accounts for the timing of medical interventions. This will drive our understanding about which patients' conditions were likely to deteriorate had the medical intervention not taken place. Focusing on temporality allows us to look at a patient's clinical data before a medical intervention and regress over the data to understand how the illness would have evolved. We will use this treated and cleaned data for developing our deep learning model for sepsis and mortality prediction. We are working with the MIMIC-III critical care database which contains the electronic medical records of over 40,000 ICU patients. This dataset is developed and maintained by the Laboratory for Computational Physiology at Massachusetts Institute of Technology [2]. It contains patient information such as the demographics, laboratory tests, vital signs, medications received, doctors and nurses' notes and more.

**Innovation/Forward Thinking:** Change Point Detection has been studied extensively over the last few decades in statistics and computer science, but only recently have the practical implementations become possible [3]. Changepoint detection algorithms are now being implemented in medical condition monitoring, climate change detection, speech detection, human activity analysis and other fields that deal with real-time time series data [3]. Developing a successful implementation of a change point detection algorithm for Septic Shock and mortality prediction would open new avenues for building similar systems for other diseases and even wellness trackers for people by using their physiological data collected from wearable sensors.

**Student Involvement:** Student Involvement is an integral part of the research and scientific investigation. Here, under supervision of the distinguished faculty members, the students will be involved in designing the research setup, analysing data, sharing their insights from the analysis with both of the computer science experts and physiology specialists, validating the results from statistical point-of-view, conducting research to make significant impact on sepsis care using this validated findings and insights from data, and developing the real-time application for iterative learning.

**References:** Paxton, Chris, Alexandru Niculescu-Mizil, and Suchi Saria. "Developing predictive models using electronic medical records: challenges and pitfalls." AMIA Annual Symposium Proceedings. Vol. 2013. American Medical Informatics Association, 2013., Johnson AEW, Pollard TJ, Shen L, Lehman L, Feng M, Ghassemi M, Moody B, Szolovits P, Celi LA, Mark RG. MIMIC-III, a freely accessible critical care database. *Scientific Data* (2016)., Aminikhanghahi, Samaneh, and Diane J. Cook. "A survey of methods for time series change point detection." *Knowledge and information systems* 51.2 (2017): 339-367.

**Keywords:** Sepsis prediction, change point detection, time series analysis, MIMIC-III

**Project Title: Quick Reaction Force: Early Detection of Crisis Warning signals in At-risk Veterans**

**Faculty Name:** Sheikh Ahamed, Professor, Mathematics, Statistics, and Computer Science

Zeno Franco, Professor, and Katinka Hooyer, Assistant Professor, Medical College of Wisconsin

**Student Name:** Olawunmi George, Md Fitrat Hossain, Adib Riddhiman

**Introduction:** Several attempts have been made at creating mobile solutions for patients with mental disorders. Many have focused on teaching the patient more about the disorder, the symptoms, how to recognize them and possible actions that can be taken when these symptoms are noticed (Franco et al., 2018, p. 874). Good as these may seem, a better approach would be one that detects the possibility of a crisis event occurring, before it occurs.

We are part of an ongoing effort to ensure better crisis detection before the occurrence of such. This project takes a mentor-mentee approach, enhanced with the use of mobile technology to help veterans be connected in their daily lives to more senior veterans, who have also gone through the same traumatic experiences and have lived to overcome them. To this end, a mobile solution has been developed, which helps mentors get constant feedback from their mentees about their daily progress and state of well-being.

**Significance:** Imperative is the need for proper mental health solutions and cares to persons with such ailments. Narrowing down the focus to US military veterans, there has been the age-long problem of mental health crises in this category of persons, with characteristic Post-traumatic Stress Disorder (PTSD), anger outbursts and different forms of violent expressions. Being able to tackle this problem, possibly significantly reducing the occurrence of these violent expressions, would be a good achievement for the military, the United States and perhaps more generally, the population of persons with mental health disorders.

**Innovation/Forward Thinking:** With the current state of this project, much more can be achieved with the introduction of newer technological methods. As stated earlier, a mobile application has already been made for the veterans and this together with its web component would continually be used to gather daily survey data from over 300 veterans. Going forward, we intend to research into the use of machine learning and statistical models to:

1. More accurately predict the chance of a crisis occurring.
2. Make use of feedback for improving the model.
3. Possibly deduce other insightful information from the data already gathered.

**Student Involvement:** Currently, three Ph.D students are assigned to this project, and would take advantage of the synergy of their differing skills in the Computer science and statistics domains.

**References:** Franco, et al. (2018), "Detecting & Visualizing Crisis Events in Human Systems: an mHealth : Approach with High Risk Veterans). Proceedings of the 15th ISCRAM Conference – Rochester, New York, May 2018.

**Keywords:** Mental health, veterans, machine learning, crisis

**Project Title: Smartphone-based Bioimaging for (Hemoglobin) Biomarker Estimation****Faculty Name:** Sheikh Iqbal Ahamed, Professor, Mathematics, Statistics, and Computer Science

Richard Love, Professor, Mathematics, Statistics, and Computer Science

**Student Name:** Md Kamrul Hasan, Md Hasanul Aziz

**Introduction:** Hemoglobin provides the oxygen-carrying capacity of blood, a critical need for optimal body organ function. Changes in hemoglobin, particularly decreases below optimal levels, compromise health and characterize multiple diseases. The fraction of the global population affected is large. For an example, just one condition-anemia (low blood hemoglobin level) because of iron deficiency- is estimated to be present in 1.6 billion people globally and more than 85% of the populations in Africa and Asia [1]. The long-established gold standard method for hemoglobin measurement involves laboratory evaluation of venipuncture obtained blood samples. This is uncomfortable, impractical when repeated measurements are needed in certain patients and for patients without easy access to health facilities, costly, inconvenient because the samples have to be transferred to a laboratory, and time-consuming. A point-of-care tool for inexpensive, accurate, non-invasive, immediate hemoglobin determination would be of major benefit to health systems, care-givers and patients worldwide.

**Significance:** Recent studies on noninvasive solutions for estimating hemoglobin levels use different approaches in feature collection and image analysis techniques [2]. In addition, there are several smartphone-based noninvasive hemoglobin (Hb) measurement technologies, such as TouchHb, Masimo-Total Hemoglobin, and Eynaemia. Most of these works suffer from one or more of the following limitations: 1) data analysis and accuracy; 2) data capturing and feature collection; 3) affordability and portability; and 4) lack of user-friendliness and addition of external modules. Recent studies on noninvasive solutions for estimating hemoglobin levels report different approaches in feature collection and image analysis techniques. There are several smartphone-based noninvasive hemoglobin (Hb) measurement technologies, such as TouchHb, Masimo-Total Hemoglobin, and Eynaemia. These tools suffer from limitations in the different areas: 1) data capturing and feature collection; 2) data analysis and accuracy; 3) affordability and portability [3]; and 4) lack of user-friendliness and addition of external modules [4]. The proposed mobile application describes the development of a smartphone-based bioimaging system which will be designed and developed for the data collection of a wide range of medical images (skin, facial, eyelid, and fingertip etc.) and for the extract of multiple data features, and identification of critical data features. Finally, the fingertip data will be used for noninvasive hemoglobin level estimation.

**Innovation/Forward Thinking:** The Ubicomp Lab of Marquette has fingertip data collected under IRB in Bangladesh. A Google Pixel 2 smartphone and infrared LED boards were used during the data collection process. We have analyzed our data and developed a prediction model. We need to validate our model getting fingertip video of a user through a mobile application and analyze that data in a cloud server. In this validation process, we are aiming to accomplish the following goals. 1) Design and develop a mobile application to capture various videos/images including fingertip, eyelid, skin, and facial images continuously, and ubiquitously without putting cognitive burden on the app users, 2) build a feature extraction process in the mobile app to reduce the latency in the data transmission over internet, 3) implement a cloud server to receive the features, authenticate, process and generate a feedback on the features based on the prediction model. The proposed mobile application is very generic, and it can be used to collect data for another biomarker identification. We already collected 213 subjects' fingertip video from Bangladesh under four infrared lighting conditions. In this project, we implement a mobile application and a cloud server to test and validate our developed prediction model.

**Student Involvement:** Md Kamrul Hasan and Md Hasanul Aziz, Graduate Students, Marquette University.

**References:** [1] McLean E, Cogswell M, Egli I, Wojdyla D, De Benoist B. Worldwide prevalence of anaemia, WHO vitamin and mineral nutrition information system, 1993–2005. *Public health nutrition*. 2009 Apr;12(4):444-54., [2] Hasan MK, Haque M, Sakib N, Love R, Ahamed SI. Smartphone-based Human Hemoglobin Level Measurement Analyzing Pixel Intensity of a Fingertip Video on Different Color Spaces. *Smart Health*. 2018 Jan 1;5:26-39., [3] Rice MJ, Gravenstein N, Morey TE. Noninvasive hemoglobin monitoring: how accurate is enough?. *Anesthesia & Analgesia*. 2013 Oct 1;117(4):902-7., [4] Bui N, Nguyen A, Nguyen P, Truong H, Ashok A, Dinh T, Deterding R, Vu T. PhO2: Smartphone based Blood Oxygen Level Measurement Systems using Near-IR and RED Wave-guided Light. In *Proceedings of the 15th ACM Conference on Embedded Network Sensor Systems*.

**Project Title: DiReCT (Diabetic Retinopathy Comprehension Tool): A Fundus Image-based Multi-parameter Scalable System for Diabetic Retinopathy Assessment**

**Faculty Name:** Sheikh Iqbal Ahamed, Professor, Mathematics, Statistics, and Computer Science

**Student Name:** Jannatul Ferdouse Tumpa, Riddhiman Adib

**Introduction:** Patients suffering from diabetes for a prolonged period are at higher risk of developing retinal complications that can eventually cause vision loss (Barber et al. 2003). Diabetic retinopathy is one such complication of diabetes and is the leading cause of blindness worldwide. Early detection through regular screening by clinical examination or grading of retinal photographs is essential in order to prevent vision loss. The main challenge with diabetic retinopathy is that the patient is not aware of the disease until the symptoms have progressed to a level where treatment tends to be less effective (Ting et al. 2016). Therefore, automated early detection would have great impact to reduce the severity of the disease and initiate treatment for those at risk. Our long-term goal is to effectively reduce the workload of ophthalmologists and aid them in the decision making, analysis, and diagnosis of diabetic retinopathy from eye fundus images. Additionally, we aim to generate a predictive model that can estimate the likelihood of developing diabetic retinopathy. Our objective for this project is to develop an automated detection algorithm for diabetic retinopathy with working system implementation.

**Significance:** The proposed research is significant on several levels. First, we propose to combine multiple algorithms to detect clinical markers of diabetic retinopathy from fundus images with different classifiers; we have reviewed the literature and found that no single algorithm itself can work efficiently to detect all the clinical markers of diabetic retinopathy from fundus images. We will build off of the best individual algorithms and optimize the parallel utilization of the algorithms to increase the speed of grading fundus images. Second, we are developing a model to predict the likelihood of developing diabetic retinopathy, which will be the first of its kind, and increase the rate of detection so that treatment costs can be minimized. Finally, we are combining the development of easier grading of fundus images with a predictive function for diabetic retinopathy that will be easy to use online and reduces the workload of ophthalmologists. Upon accomplishment of this project, ophthalmologists will be able to dedicate their efforts to treating more complex patients rather than spending time grading numerous images, and patients with diabetes who have difficulty accessing eye-health exams will have increased access through our platform.

**Innovation/Forward Thinking:** Primarily, instead of using one algorithm for overall detection of DR, our approach combines several optimized algorithms for individual clinical markers to generate a retinal disease distribution matrix. This approach is more reliable and can run multiple algorithms in parallel to find out all possible signs of DR from the retinal images. Generating a final decision about the presence of DR from the matrix that detects each DR sign can be more accurate and applicable for small databases, our own database is unique in having >1,000 participants. We also propose a method for combining an individual's fundus images and biomedical information to predict future development of DR. To the best of our knowledge, no research has been done to reveal the relationship between DR risk and a patient's biometric information. This is the first instance of building a real predictive system for DR detection by using biometric data. Millions of people with diabetes will benefit directly from our system.

**Student Involvement:** Jannatul Ferdouse Tumpa: Idea generation, Mathematical model development for automated detection of diabetic retinopathy.

Riddhiman Adib: Pre-processing and analysis of Fundus retinal images, System development.

**References:** Barber, A. J. (2003). A new view of diabetic retinopathy: a neurodegenerative disease of the eye. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 27(2), 283-290.,

Ting, D. S. W., Cheung, G. C. M., & Wong, T. Y. (2016). Diabetic retinopathy: global prevalence, major risk factors, screening practices and public health challenges: a review. *Clinical & experimental ophthalmology*, 44(4), 260-277.

**Keywords:** diabetic retinopathy, automated detection, image analysis, modular system

**Project Title: Immunohistochemical Expression of GRP78 in Discs of Patients with Temporomandibular Joint Disorder**

**Faculty Name:** Luis Almeida, Clinical Assistant Professor, School of Dentistry

**Student Name:** Timothy LeMoine

**Introduction:** Temporomandibular disorders (TMD) are both musculoskeletal and neuromuscular conditions that involve the temporomandibular joint, associated musculature, and local osseous components.<sup>4,5</sup> The etiology for TMDs are very poorly understood. Theories are multifactorial, including but not limited to biological, social, emotional, environmental, and cognitive influences. The purpose of our study is to assess how Glucose Regulated Protein 78 (GRP78) affects the pathogenesis of TMD. An immunohistochemical procedure will be completed in order to analyze articular disc samples of patients with a TMD diagnosis; these results will be used as a comparison to those without any TMJ symptoms. For reference, immunohistochemistry is a staining technique involving the isolation of antibodies through their specific antigens. Additional staining techniques are then utilized to produce images where these antigens are visibly expressed.

**Significance:** Shaffer, Stephen M et al. studied the etiology of TMD and the difficulty surrounding TMD diagnosis as well as classification of different related pathologies.<sup>4</sup> One meta-analysis notes that 16% of the adult population experiences some type of TMD that requires medical intervention.<sup>4</sup> The number of affected individuals is likely higher than this, given not all TMD patients require therapy, and symptoms can fluctuate over time. The etiology of TMD are very poorly understood and treatment varies greatly. Treatment of these disorders aims to increase joint motion, decrease pain during mastication, and prevent further damage and degeneration to the articular disc and surrounding tissues. Our research will focus on the etiologic influence GRP78 holds in TMD, as well as the resulting pathology mechanisms. This research could impact the diagnosis and treatment of temporomandibular disorders, allowing clinicians to better understand the clinical presentation of pain and ultimately improve treatment protocols.

**Innovation/Forward Thinking:** This study will use articular disc samples from healthy individuals to compare to those taken from patients with temporomandibular joint disorder. Controls of this kind are difficult to attain. This design is unique in that these non-affected controls will allow for a greater analysis of the results that will prove more significant. Understanding the etiology of diseases of the TMJ is crucial to developing more concise and effective treatment modalities.

**Student Involvement:** Predoctoral students involved in Dr. Almeida's research group at the Marquette School of Dentistry have responsibilities that include development of the protocol, performing IHC trials, analyzing the results, and writing the subsequent publication. Dr. Almeida plays a strong role in mentoring the dental students through this process.

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**Keywords:** Temporomandibular Joint Disorder, Glucose Regulated Protein 78, Immunohistochemical Analysis, Etiology

**Project Title: Immunohistochemical Expression of CASP3 in Discs of Patients with Temporomandibular Joint Disorder**

**Faculty Name:** Luis Almeida, Clinical Assistant Professor, School of Dentistry

**Student Name:** Logan Herm

**Introduction:** The aim of this study is to look at a biomarker, Caspase-3 (CASP3), and its involvement in the pathogenesis of temporomandibular disorder (TMD). TMD is a degenerative disorder of the temporomandibular joint (TMJ) with a multifactorial etiology and risk factors such as parafunctional activity, emotional stress, trauma, and female gender (Almeida et. al., 2018; Okeson, 2008). TMD is a degenerative disease that involves anterior displacement of the articular disc of the TMJ, joint remodeling in an attempt to adapt, and potential progression to inflammation and osteoarthritis of the joint components (Almeida et. al., 2018; Murphy et. al., 2013). CASP3 is a gene in the apoptotic pathway, an important process that is largely involved in the remodeling process of TMD (Lavrik, 2005). Due to the importance of apoptosis in adaptation of the TMJ apparatus in TMD, we hypothesize that CASP3 will be upregulated in the TMJ disc tissues of patients affected by TMD relative to unaffected controls.

**Significance:** According to Murphy et. al., TMD affects up to 25% of the population, and because the etiology and pathogenesis are not completely understood, treatment options and diagnostic tools are limited. Current diagnosis involves evaluation of clinical signs and symptoms (Okeson, 2008). However, having a distinct biomarker could give better insight into the patient's stage of disease. Similarly, treatment of TMD tends to be restricted-either therapeutic or surgical. Given distinct biomarkers, pharmacological options could be used as an adjunct to the currently available treatments, or possibly on their own, to treat TMD (Okeson, 2008). Our research will attempt to identify a biomarker, CASP3, that may be utilized to improve both diagnostic and treatment modalities in patients with TMD.

**Innovation/Forward Thinking:** There are a large number of disorders that affect the TMJ, and current diagnostic and treatment modalities are limited. Identification of specific gene involvement and biomarkers, such as CASP3, could provide a gateway into not only researching a possible pharmaceutical targets and diagnostic tools, but also progressing the evolution of the management of these debilitating disorders. Our study involves tissue samples that are normally very difficult or impossible to obtain, affording us unique research opportunities. To date, there have been no studies involving the use of immunohistochemical staining to identify the upregulation of CASP3 in the TMJ disc tissue involved in TMD.

**References:** Almeida, Luis Eduardo, et al. "Immunohistochemical Expression of TLR-4 in Temporomandibular Joint Dysfunction." *Cranio*, 2018, pp. 1–6.,  
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**Keywords:** Temporomandibular Disorder (TMD), Temporomandibular Joint (TMJ), Caspase-3 (CASP3), Immunohistochemical staining

**Project Title:** Calculation of scattering resonances in ozone using stabilization method

**Faculty Name:** Dmitri Babikov, Professor, Chemistry

**Student Name:** Elizaveta Grushnikova

**Introduction:** The presence of ozone layer in atmosphere of Earth is peculiar and substantial, because it protects life on Earth from harmful ultra-violet radiation. Study of the ozone formation mechanism helps to understand development of planetary atmosphere. In particular, we focus on anomalous mass-independent isotope effect. In 1981 Mauersberger's group performed the experiment with balloon flight measurement, as a result of which discovered anomalous isotope effect for ozone formation. Since then chemists currently continue the theoretical investigation of this phenomenon.

**Significance:** The study investigate the reaction which is responsible for the reconstruction of ozone layer, which protects life on Earth from harmful ultra-violet radiation and explains the development of planetary atmosphere of Earth.

**Innovation/Forward Thinking:** There were only couple of papers where the mass-independent isotope effect was computed and found to roughly agree with the experimental data. In this work mass-independent isotope effect in ozone formation is approached using new and efficient method, which includes several modern techniques.

**Project Title: Inferring disease-specific competing endogenous RNA (ceRNA) interactions****Faculty Name:** Serdar Bozdag, Assistant Professor, Mathematics, Statistics, and Computer Science**Student Name:** Ziyet Nesibe Kesimoglu, Sarah Alhakimi

**Introduction:** MicroRNAs (miRNAs) are one of the non-coding RNA types that regulate RNA expression by binding to them. There is a regulation multiplicity between miRNAs and RNAs, meaning that a miRNA could have multiple RNA targets, and an RNA could be targeted by multiple miRNAs. Furthermore, recently it has been discovered that RNAs targeted by common miRNAs could "compete" for these miRNAs and thereby regulate each other indirectly (Salmena, Poliseno, Tay, Kats, & Pandolfi, 2011). Such RNAs are called competing endogenous RNAs (ceRNAs). It has been shown that ceRNA interactions have key roles in several disease conditions including cancer (Peng et al., 2015). Giving the enormous number of RNAs in the genomes, it is cost and labor prohibitive to identify ceRNA interactions experimentally. Thus, several computational studies have been developed to infer ceRNA interactions from biological datasets. One of these tools is Cancerin (Do & Bozdag, 2018), a tool developed in our lab. Cancerin integrates multiple types of biological datasets to infer cancer-associated ceRNA interactions. In this proposed study, we aim to extend Cancerin to address some of its drawbacks. Based on the premise that several ceRNAs could work together to sequester miRNA(s) targeting one or more key ceRNAs, we will extend Cancerin to infer group-wise interactions among ceRNAs besides pairwise ceRNA interactions. In the current computational studies, including ours, a miRNA could be assigned to "mediate" thousands of ceRNA interactions without considering if the miRNA has sufficient abundance. We will extend Cancerin to address this issue, too. Furthermore, we will integrate time series expression datasets to infer directional ceRNA interactions.

**Significance:** Approximately four fifth of the human genome is transcribed to RNA. While only less than 2% of the human genome is responsible for coding proteins, the remaining part has many regulatory elements, most of which are not demystified. Current experimental methods cannot identify genome-wide ceRNA interactions. Our computational tool will help identify putative ceRNA interactions genome-wide, which would shed light on the underlying complex regulatory circuitry in disease conditions. Our tool would enable researchers to find potential disease drivers and key regulatory interactions.

**Innovation/Forward Thinking:** This study will utilize various biological data types to infer ceRNA interactions. We will identify group-wise ceRNA interactions, which could not be possible to detect using pairwise-based methods only. Most studies cannot infer the directionality of the ceRNA interactions. We will identify directed ceRNA interactions, which will help us identify potential key ceRNAs associated with diseases.

**Student Involvement:** Ziyet will work on the computational experiments in this project under Dr. Bozdag's supervision.

**References:** Do, D., & Bozdag, S. (2018). Cancerin: A computational pipeline to infer cancer-associated ceRNA interaction networks. *PLoS Computational Biology*, 14(7), 1–23. <https://doi.org/10.1371/journal.pcbi.1006318>, Peng, W., Si, S., Zhang, Q., Li, C., Zhao, F., Wang, F., ... Ma, R. (2015). Long non-coding RNA MEG3 functions as a competing endogenous RNA to regulate gastric cancer progression. *Journal of Experimental and Clinical Cancer Research*, 34(1), 1–10., Salmena, L., Poliseno, L., Tay, Y., Kats, L., & Pandolfi, P. P. (2011). A ceRNA hypothesis: The rosetta stone of a hidden RNA language? *Cell*, 146(3), 353–358. <https://doi.org/10.1016/j.cell.2011.07.014>.

**Keywords:** genome-wide ceRNA interactions, miRNA sponge interactions, miRNA-mediated networks

**Project Title:** Transforming Colorblind Worldviews: A Grounded Theory of the Process of Becoming Racially Aware  
**Faculty Name:** Jennifer Cook, Assistant Professor, Counselor Education and Counseling Psychology  
Caroline O'Hara, Assistant Professor, Syracuse University-Counselor Education  
**Student Name:** James McDonald, Mitchell Schramper

**Introduction:** In US culture, *colorblindness* is a ubiquitous belief system that asserts all human beings are the same, therefore race should be ignored, each person should be treated as an individual, and the focus should be on our shared humanity (Neville et al., 2016). Embedded within this ideology is the belief that US has eclipsed racism and race is no longer relevant, that is, we now live in a *post-racial society*. Colorblind racial ideology typically consists of two interrelated principles: *color-evasiveness*, when people emphasize similarities between people of different racial groups, and *power-evasiveness*, in which people emphasize equal opportunity (Neville et al., 2013). Racial differences exist in the US, and social structures continue to privilege people who are White over people of color. Colorblind worldviews of any type serve to perpetuate oppression, discrimination, and structural inequality (Apfelbaum et al., 2012; Johnson et al., 2009; Johnson, & Jackson Williams, 2015). Furthermore, color-evasiveness can negate the experiences (positive and negative), culture, and uniqueness of people of color, while power-evasiveness can serve as a mechanism to blame people of color based on the myths of the American dream and US meritocracy.

**Significance:** It is essential for counselors to understand and incorporate clients' cultural identities into treatment (ACA, 2014). Researchers have found counseling treatment outcomes and client attrition are impacted positively when counselors integrate clients' culture during counseling (Lee & Ramsey, 2006; Toporek & Pope-Davis, 2005). The vast majority of US counseling professionals identify as White (APA, 2016) and most people who seek counseling will have a White counselor. Middleton et al. (2005) found that when White counselors have a more developed racial identity, which includes not holding colorblind worldviews, they had higher cultural competence. Neville et al. (2006) and Johnson and Jackson Williams (2015) corroborated Middleton et al.'s (2005) findings. Given these findings, we scoured the literature to find studies about the factors that lead to transforming colorblind worldviews yet were unable to identify any. Because preliminary evidence that counselors who hold racially aware worldviews have stronger cultural competence and thus provide more culturally appropriate client care, we believe empirical information is needed to help counselors understand how they can move from colorblindness to racial awareness. Therefore, we devised a qualitative study (grounded theory) to develop a theory of how White counselors transitioned from a colorblind worldview to a racially aware worldview. We endeavor to answer the research question: What critical events, factors, etc. allow White counselors to develop a racially aware worldview and shed colorblind worldviews? We believe this study can impact the counseling profession significantly including client interactions, training modalities, and counselor supervision.

**Innovation/Forward Thinking:** Currently, our project is in the development stage; we have reviewed the literature, written a preliminary literature review, determined our sample, and established our research question. Data collection and analysis will begin in January 2019, and we plan to submit manuscripts for peer-reviewed publication in Summer 2019. Additionally, we are submitting two conference proposals to present our findings. Two students, one master's level and one doctoral level, are collaborating with two faculty members, one from Marquette University (MU) and one from Syracuse University (SU).

**Student Involvement:** This project was devised initially by the master's level student and the MU faculty member. Everyone on the research team has participated as equal collaborators, with the faculty members teaching and mentoring the students. Everyone has an equal voice with project decision making, with the faculty members teaching and guiding the students regarding how to make critical research project decisions. Although we are early in our process, we plan to continue with the same collaborative mentoring framework throughout data collection, analysis, and manuscript development.

**References:** American Counseling Association (2014). ACA code of ethics. Alexandria, VA: Author. American Psychological Association. (2016). 2015 survey of psychology health service providers., Foulke, M. L. (1996). Coming Out as a White/Becoming White: Racial Identity Development as a Spiritual Journey. *Theology & Sexuality*, 522-36. Helms, J. E. (1990, 2008). A race is a nice thing to have: A guide to being a White person or understanding the W, Johnson, A., & Jackson Williams, D. (2015). White racial identity, color-blind racial attitudes, and multicultural counseling competence. *Cultural Diversity and Ethnic Minority Psychology*, 21(3), 440. Lee, C. C. & Ramsey, C. J. (200, Neville, H. A., Gallardo, M. E., & Sue, D. W. E. (2016). The myth of racial color blindness: Manifestations, dynamics, and impact. Washington, DC: American Psychological Association., Richardson, T. Q., & Molinaro, K. L. (1996). White counselor self-awareness: A prerequisite for developing multicultural competence. *Journal of Counseling and Development*, 74(3), 228-242.

**Keywords:** colorblind worldview, counseling, White racial identity development, racial awareness

**Project Title: Voltage controlled Resistive and Capacitive Response of Nematic Liquid Crystal (LC) and LC Composites for DC and RF Switching Applications**

**Faculty Name:** Ronald Coutu, Professor, Electrical and Computer Engineering

**Student Name:** Mohiuddin Munna

**Introduction:** Liquid Crystal (LC) are widely used in display devices, electro-optic modulators, and optical switches. In these types of devices an electric field is applied which modulates the optical properties of the LC material. There are only a few works done on all electrical switches and sensors. In this research, our goal is to design, simulate, and fabricate LC switching devices (both DC and RF) and test the capacitive and resistive responses under DC and low frequency AC voltage using various electrode configurations. We will study electrode configurations that result in high sensitivity, low response time, and high on/off ratio.

**Significance:** Liquid crystal (LC) is prevalent in display technologies. Growth and processing for LC material is well established methods. Also, electro-optics switches, made from LC material, consumes less or comparable power than electronic switches. Considering all these uses of LC material in RF switches may open a new avenue for a low-cost solution.

**Innovation/Forward Thinking:** Resistivity and capacitance/dielectric constant changes in pure LCs tend to be very small with applied DC and low frequency AC electric field, which makes traditional LC a less preferable choice for DC and RF switching applications. [1] When nanoparticles (i.e. Au, CNT, TiO<sub>2</sub>, etc.) are mixed with traditional LC materials, the resulting composite LC material become more responsive to resistive and capacitive switching applications [2-3]. The conductivity of composite LC material can change 2 to 3 orders of magnitude, compared to only 2-3 times change when using unaltered liquid crystals. Similarly, the modulation in capacitance also increases. On the contrary, reversible switching is a challenge for LC composite [4]. In addition to that local heating can drive the LC composite from nematic to isotropic phase [5]. These issues need to be addressed to make a reliable switch. We will investigate composite liquid crystal, as well as pure liquid crystal as a switching material for DC and RF switching. We will use micromachining processes to fabricate our novel switching devices. During DC testing, response time, settling time, on/off ratio for the DC switching will be investigated. During RF testing, the insertion loss, isolation etc. will be compared for RF switching applications. In both RF and DC applications, we expect that LC composites will have improved performance over pure LC materials.

**Student Involvement:** Mohiuddin Munna is a Ph.D. student in Dept. of EECE, at Marquette university. His research focus is on fabrication and characterization of RF switches.

**References:** Guralnik, I. R., et al. "Interdependence of the electrical and optical properties of liquid crystals for phase modulation applications." *Journal of Applied Physics* 87.9 (2000): 4069-4074.,  
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**Keywords:** Liquid Crystal, DC and DF switch, LC composite

**Project Title: MEMS Membrane based Photo-acoustic Detection for Hazardous Gas Sensing Application****Faculty Name:** Ronald Coutu, Professor, Electrical and Computer Engineering**Student Name:** Turja Nandy

**Introduction:** There are lots of hazardous gases such as carbon monoxide, carbon dioxide, ammonia, etc. which are very harmful to human beings as well as being environmental pollutants. High concentrations can immediately affect vital organs and long-term exposure to low concentration can also create severe health issues (specially to children and pregnant women). Some gases are colorless and tasteless so that they are undetectable through human senses. So, their detection in both household and residential environment is very necessary. Present commercialized metal oxide semiconductors (MOS) based sensing devices are mainly based on electrical property variation of sensing material while interacting with gases [1]. But the interaction with the oxide layer degrades the material which decreases the life-time. For surpassing these, some researchers have investigated optical based gas sensors [2]. The optical approach is based on vibration detection and pressure difference created from light-gas interaction (photo-acoustic phenomena) [3]. These optical sensors showed greater sensitivity, selectivity and better lifetime than MOS. But present optical sensors are so expensive and bulky. That is why we introduce low-cost microelectromechanical systems (MEMS) membrane. Our main purpose is to develop a cost-effective MEMS membrane based photoacoustic (PA) detection system for sensing hazardous and toxic gases.

**Significance:** The main advantages of this project will be: (a) Saving the environment and human health: This sensing system can be used in every home, laboratory, industry etc. which can save us from dangerous toxic gases; (b) Multi-functionality: By changing the infrared (IR) source according to the absorption line, this single system can be used for different hazardous gases; (c) Huge life-time: Gas sensing via micro-machined membrane-based PA detection system has no direct physical interaction that is why it will have longer lifetime; (d) Miniaturized structure: This system will have micro-sensing membrane and miniaturized test structure which can be easily fit anywhere; (e) Low-cost manufacturing: MEMS industry related batch fabrication method will be used which will reduce the cost significantly.

**Innovation/Forward Thinking:** In this research, we will introduce MEMS membrane-based photo-acoustic (PA) detection system for hazardous gas sensing application with high accuracy and low cost. We will use thin and deformable micromachined SOI membrane to detect the acoustic vibration created via light-gas interaction inside the PA chamber. In this work, we will analyze the theory behind photo-acoustic phenomena and pressure change inside gas chamber for proper modeling of MEMS membrane. Then, we will fabricate MEMS membrane and prepare the whole optical experimental set-up with LED based IR light source and detector according to the absorption spectra of target gases. Finally, we will detect the membrane deflection through white light interferometer. These deflection values will give the sensitivity towards the particular gas.

**Student Involvement:** Turja Nandy did literature review, modeling and simulation. Now he is working on the experimental set-up and fabrication process. Then he will start to take data and analyze them.

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**Keywords:** Microelectromechanical systems (MEMS), Gas sensor, Photo-acoustic (PA), Infrared (IR)

**Project Title:** A novel method of testing ultrasonic transducers using a modified acoustic microscope.

**Faculty Name:** Ronald Coutu, Professor, Electrical and Computer Engineering

**Student Name:** Mohammad Shakhawat Hossain

**Introduction:** Scanning Acoustic Microscopes (SAMs) are very commonly used in failure analysis and non-destructive evaluation. Such devices use a focused sound wave for scanning an object. In this work, we aim to develop a novel methodology for testing ultrasonic transducers integrated into microelectromechanical systems (MEMS) using a modified acoustic microscope. Our ultimate-goal is to design an accurate model for capacitance measurement and investigate the transmitter/receiver characteristics of micro-machined ultrasound transducers.

**Significance:** Capacitive Micromachined Ultrasound Transducers (CMUTs) cells are composed of a Silicon substrate, an acoustic membrane and an electrode. Structurally, it functions much like an ordinary capacitor. Since CMUTs are Silicon-based devices, they are very cost-effective when it comes to fabrication process. As most of the commercial ultrasound transducers are based on piezoelectricity, and their functionality mimics that of a capacitor, they are an ideal candidate for sensing pressure or fluid flow. Taking all these considerations into account, ultrasound transducers have the potential to offer a new direction in cost-effective sensing devices.

**Innovation/Forward Thinking:** CMUT is a relatively new branch in the field of ultrasonic devices. There have not been many works done with them and their transmitter/receiver duality characteristic offers great promises for sensing pressure. With the increasing complexity of the devices, new challenges in CMUT operations also appear and our aim is to develop a robust testing method to better understand the acoustic sensor.

**Student Involvement:** Mohammad Shakhawat Hossain is a Ph.D. student at the Department of Electrical and Computer Engineering, Marquette university. His research focus is on fabrication and characterization of ultrasonic devices.

**References:** Cristman, P., Oralkan, O., Zhuang, X., Ma, T.-J., Vaithilingam, S., Carver, T., Khuri-Yakub, B. T. (2009). A 2D CMUT hydrophone array: Characterization results. In *Ultrasonics Symposium (IUS), 2009 IEEE International* (pp. 992–995). IEEE.,

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F, Zhou, H., Lin, W., Ge, X., & Zhou, J. (2016). A non-intrusive pressure sensor by detecting multiple longitudinal waves. *Sensors*, 16(8), 1237.,

Emadi, T. A., & Buchanan, D. A. (2013). Multiple moving membrane CMUT with enlarged membrane displacement and low pull-down voltage. *IEEE Electron Device Letters*, 34(12), 1578–1580.,

**Keywords:** Scanning Acoustic Microscope, Ultrasound, CMUT

**Project Title: Improved and Optimized Microcontact Test Fixture for Evaluating Micro-switch's Reliability and Performance**

**Faculty Name:** Ronald Coutu, Professor, Electrical and Computer Engineering

**Student Name:** Protap Mahanta

**Introduction:** Microswitches are an example of a MEMS technology that is considered promising for radio frequency (RF), satellite and automated test equipment (ATE) applications. Past research has shown MEMS switches are able to deliver outstanding performance in terms of low contact resistance, near-zero power consumption and very low insertion loss. Unfortunately, they suffer from reliability issues that prevent their widespread use by industry.

**Significance:** In MEMS switches, the microcontact region plays the critical role in determining the device lifetime and reliability. Hence, the study of the failure physics (adhesion, contamination, stiction, material transfer, etc.) and optimization of design parameters (contact resistance and contact force) associated with microcontact impose the need for a simple, quick, versatile and efficient test fixtures.

**Innovation/Forward Thinking:** Prior studies from the literature have shown modified nanoindentors and atomic force microscopes (AFM) being used to perform microcontact reliability and performance studies. However, they are limited to cycle rates of 10-100 Hz and therefore severely inhibit microswitch lifetime testing where billions of cycles are needed to show acceptable device reliability. This work proposes an improved test fixture that simplifies assembling, contact fabrication process and postmortem analysis of contact support structure. We will fabricate the contacts using silicon on insulator (SOI) micromachining techniques which enable a very simple and efficient way of performing the postmortem analysis of microcontacts.

**Student Involvement:** Protap is involved in this project since August 2017. He has got some simulated data from the theoretical model and now working on towards the assembling and fabrication of contact support structure associated with this project.

**References:** Toler, B. F., Coutu Jr, R. A., & McBride, J. W. (2013). A review of micro-contact physics for microelectromechanical systems (MEMS) metal contact switches. *Journal of Micromechanics and Microengineering*, 23(10), 103001.,  
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**Project Title: Design and Fabrication of Capacitive Micromachined Ultrasonic Transducers (CMUT) device to measure multiple fluid-parameters**

**Faculty Name:** Ronald Coutu, Professor, Electrical and Computer Engineering

**Student Name:** Ashish Mishra

**Introduction:** Ultrasonic sensing devices are non-contact sensors that can be used for measuring quantities such as fluid flow, pressure, etc. An example of an ultrasonic devices is a hydrophone which can sense changes in liquid pressure and then convert that to electrical signals via the piezoelectric effect. We propose to build a miniature acoustic sensor to measure multiple physical quantities.

**Significance:** Capacitive micro-machined ultrasonic transducers (CMUT) are a Microelectromechanical System (MEMS) based miniature, cost-effective acoustic technology that has great potential for measuring liquid flows and pressures [1, 2, 3].

**Innovation/Forward Thinking:** Our novel idea is to make the CMUT-array sensor which will be measuring three physical quantities at once which are flow-rate, temperature and pressure of the fluid using the single sensing device.

**Student Involvement:** Ashish Mishra, a visiting scholar, has conducted literature survey on this project and wrote the abstract.

**References:** Cristman, P., Oralkan, O., Zhuang, X., Ma, T.-J., Vaithilingam, S., Carver, T., Khuri-Yakub, B. T. (2009). A 2D CMUT hydrophone array: Characterization results. In Ultrasonics Symposium (IUS), 2009 IEEE International (pp. 992–995). IEEE.,

Wygant, I. O., Zhuang, X., Yeh, D. T., Oralkan, O., Ergun, A. S., Karaman, M., & Khuri-Yakub, B. T. (2008). Integration of 2D CMUT arrays with front-end electronics for volumetric ultrasound imaging. IEEE Transactions on Ultrasonics, Ferroelectrics,

F, Zhou, H., Lin, W., Ge, X., & Zhou, J. (2016). A non-intrusive pressure sensor by detecting multiple longitudinal waves. Sensors, 16(8), 1237.

**Keywords:** Acoustic sensors, CMUT devices, MEMS technology

**Project Title: Measuring Social Justice: Developing a More Valid Instrument****Faculty Name:** Nicholas Curtis, Director of Assessment, Office of Assessment**Student Name:** Margaret Stacy-Duffy

**Introduction:** The Social Justice Scale was designed to "measure social-justice related values, attitudes, perceived behavior control subjective norms, and intentions based off a four-factor conception Ajzen's theory," (Torres-Harding, Siers & Olson, 2011, p. 77). The current project will apply anchoring vignettes (King & Wand, 2006) to the Social Justice Scale to account for social desirability and correct for conceptual differential item functioning at the instrument level. The adjustment will allow a more accurate representation of the construct of social justice.

**Significance:** The significance of this project is in the potential to provide more accurate inferences about social justice related values, attitudes, norms, and intentions. In making additions to the existing instrument, the Social Justice Scale (2011), we can increase the validity of the inferences made from the scores such that we can be more confident that scores relate to social justice. Whenever students respond via self-report, that information is inherently biased since without comparison or context, there is potential for conceptual differential item functioning (Curtis, 2013). Social desirability is also an issue that arises in self-reporting and can affect the data (Curtis, 2013). To account for these issues in self-reporting instruments, anchoring vignettes will relate to each item on the scale. These vignettes will entail asking respondents to rate a hypothetical individual situation which would then anchor their response by putting their understanding of their own report in context (Curtis, 2013; King & Wand, 2006).

**Innovation/Forward Thinking:** This type of work has not been done within the context of social justice and would allow for a more trustworthy measure. Doing so would offer information to better understand how students learn and develop within their understanding of social justice, which would then in turn provide more information on how to best teach and support students in their social justice learning and development.

**Student Involvement:** The student involvement in this project, aside from the graduate student as the lead researcher, would primarily be the undergraduate students who will be responding to the instrument. In future planned research, focus groups and Think-Aloud Protocols with students who have taken the instrument would be helpful to better understand how they interacted with it and perceived it. Also, focus groups with students on how they understand their learning and engaging with social justice would also be useful to the nature of this project.

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**Keywords:** social justice, measurement, validity

**Project Title: The Human-Computer Interactions of Algorithmic Crime Analysis****Faculty Name:** Shion Guha, Assistant Professor, Mathematics, Statistics, and Computer Science**Student Name:** Katherine Weathington, Chris Supinger

**Introduction:** Our previous research and literature review has shown that two algorithms commonly used by crime analysts to inform distribution of police resources are the K-Means clustering algorithm and Kernel Density Estimations. The K-Means works by partitioning past data points into a number of clusters,  $k$ , provided by the user based on distance. KDEs use previous data points to approximate the distribution of data points. These algorithms function very differently, utilizing different parameters and giving vastly different outputs. We look to examine the difference in how stakeholders and experts interpret and utilize these different algorithms, as well as the difference in interpretation between groups of different expertise in the form of a comprehensive human-computer interaction (HCI) experiment.

**Significance:** This work will give insights valuable in several different ways. First of all, we will examine the human-computer interaction for both K-Means and KDEs in general. We will also find insights into how people with different education levels interpret algorithmic outputs. This will help the makers of future algorithms and software understand how to make their solutions accessible and transparent to the most common denominator of stakeholders. Further, we hope to help optimize how crime labs utilize and interpret algorithms.

**Innovation/Forward Thinking:** The first step of this project is to build an interactive KDE application where we can host our experiment. We have previously made such an application for K-Means, though significant changes and functionalities will have to be added. Once we have finished the programming aspect, we will perform an experiment on various segments of the population, ranging from non-expert community members to educate crime analysts. Our currently proposed experiment design, which may change as technological constraints manifest, is to have each subject place a limited number of 'pins,' representing the allocation of limited police resources, on some number of K-Means outputs and KDE outputs. The subjects will fill out an exit survey. Analyzing and interpreting the results of this experiments will be the final phase of the project before paper writing and conference submission.

**Student Involvement:** The undergraduate and graduate student are responsible for writing the software. They are also largely involved in the experimental design and will administer the experiment. Both students will be largely responsible for the analysis and interpretation of experiment results. Finally, both students will contribute to the final paper. In short, the students will be the major contributors to every step of the project.

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**Keywords:** Human-Computer Interaction (HCI), Algorithms, Crime, Accessibility

**Project Title: Foster Care in Wisconsin: Improving Placement Stability A data-driven approach****Faculty Name:** Shion Guha, Assistant Professor, Mathematics, Statistics, and Computer Science**Student Name:** Devansh Saxena

**Introduction:** The number of children that are placed in the foster care system in the United States is rising every year. This places a significant burden on the Child Protective Services (CPS) agencies in every state that are already underfunded and overburdened [1]. Therefore, we must find novel methods that could be employed with limited funding and yet achieve significantly better results. In this proposed study, we focus our attention to the Foster Care System in Wisconsin and seek to improve the placement stability rate through data-driven methods.

**Significance:** Child abuse and neglect are severe issues that every state in the United States continues to battle with. In September 2016, there were 437,465 children in the foster care system in United States. This is a significant rise from 396,966 children that were in the foster care system in September 2012 [2]. This number is expected to keep rising unless proper measures are taken towards finding permanency for these children [2]. Majority of the children who are removed from their homes and placed in the foster care system are victims of abuse and neglect and lack an adequate emotional support system that is imperative for their personal growth and well-being [3]. Children who undergo multiple moves in the foster care system have been found to develop emotional and behavioral problems, struggle academically and find it difficult to develop any meaningful relationships with foster parents or other caretakers [3]. Therefore, it is paramount to ensure that these children spend as little time in the foster care system as possible and that immediate efforts are made to achieve permanency.

**Innovation/Forward Thinking:** Our data-driven approach utilizes both qualitative and quantitative methods. We have been approved to receive data from the Wisconsin Department of Children and Families (DCF). This would allow us to analyze all the placement decisions from a quantitative and big-data perspective. We will also conduct interviews with the case-workers, foster parents and foster home owners to gain a more qualitative perspective on the foster care system. We will analyze these interview using Grounded Theory, an interpretive social science approach. Combining the data from both the qualitative and quantitative approaches, we intend to build a Child-Parent matching model. The novel idea behind the matching algorithm is that by fully understanding and capturing all perspectives, caseworkers can make better choices in placing children and, thereby, reduce placement disruptions, and therefore, a higher placement stability rate

**Student Involvement:** Student Involvement is an integral part of the research and scientific investigation. Here, under supervision of the faculty member, the student will be involved in designing the research setup, conducting interviews, analysing data, sharing their insights from the analysis, validating and publishing the results.

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**Project Title: "The Impact of Slang Language: It's Effect on Relationships Between Adolescents and Health Professionals"**

**Faculty Name:** Kristin Haglund, Associate Professor, College of Nursing

**Student Name:** Amanda McKeown, Marina Palmieri

**Introduction:** This project came about through our work with Dr. Kristin Haglund on her research project titled "Preventing Teen Dating Violence by Changing Responses to Precursor Behaviors: An Action Research Project with Girls of Color and Their Partners," funded by Marquette University's 2016 Center for Gender and Sexualities Studies (CGSS) Women and Girls of Color Research Initiative Grant. We worked with adolescents in the Milwaukee area ranging in age from 12 to 17. The project included interviewing teenagers about their struggles with relationships and violence. From the interviews, scripts were developed that portrayed common themes the teenagers discussed. The next portion of the project was to have the participants perform the scripts in small groups and then discuss their thoughts on the issues. Some of the teenagers commented on the use of slang language in the scripts, as well as used slang language when conversing. Through our interactions and discussions, a question arose: What is the impact of the use of slang language on relationships between adults and teens? How do young people want to be portrayed in relation to language?

**Significance:** As future healthcare professionals, we recognize and understand the health disparities between young people of color here in Milwaukee and across the country. Young people are generally healthy; their primary health issue is higher rates of risk behaviors. An example of a risk behavior that can lead to adverse consequences in adolescents is lack of pregnancy prevention. It was found in 2017 that 13.8% of youth in the United States did not use any method to prevent pregnancy during the last sexual intercourse (Centers for Disease Control and Prevention (CDC), 2017).

Adolescents of color experience disproportionately high adverse consequences from health risk behaviors, such as unplanned pregnancies and infections such as HIV (Sanders-Phillips, Settles-Reaves, Walker, & Brownlow, 2009). Our project aims to discover the best way for nurses to interact with young people, particularly those of color and/or poverty who are at high risk for health disparities. Clear, effective, and accurate communication between young people and health professionals is key in addressing health disparities. Understanding definitions of slang terms and when/where it is appropriate and respectful to use these terms according to adolescents' preferences has the potential to positively impact relationships (Haglund, Schaeuble, & Vukovich, 2010). For example, connecting a slang term to a medical term may help with health literacy and communication between healthcare professionals and young patients (Cecchino & Morgan, 2009). Ultimately, our goal is to discover how we can communicate with young patients in ways they would like us to in regards to language. The data we collect has the potential to change the way nurses interact with adolescents and positively impact their health outcomes and literacy.

**Innovation/Forward Thinking:** In nursing, the focus is often on how we can meet patients' needs. We are using a community-based participatory research approach. We intend that researchers and participants will experience bi-directional benefits through their participation. It is innovative to actually go to a group of young people and ask how they can teach us how to meet their needs more effectively, and therefore make us better healthcare professionals. In our project, we are actively reaching out to young people in the Milwaukee area to ask them what slang language means to them and how it should be used (or not used) when communicating with healthcare professionals. Rather than focusing on weaknesses, our project is strength based in that it focuses on adolescents' attributes and how they can make a positive difference in their healthcare. Additionally, our project is directed by the youth themselves rather than asking their parents or other professionals.

**Student Involvement:** As students, we assisted Dr. Haglund with data collection and analysis in the interview and script processes at the COA Riverwest in Spring and Summer of 2018. We developed a dictionary of slang terms from the interviews with the young people. Moving forward, we will lead the proposed research study by developing the process for data collection and interview guide, recruiting participants, and facilitating script readings and discussions among the teenagers at the COA Riverwest. We will analyze the data collected, draw conclusions, and prepare presentation and manuscript for dissemination with the assistance of Dr. Haglund.

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**Keywords:** Adolescents, Slang Language, Health Disparities, Community Engagement

**Project Title: Explicit intervention for Spanish pragmatic development during short-term study abroad: A focus on the speech act of apologies**

**Faculty Name:** Todd Hernandez, Associate Professor, Languages, Literatures and Cultures

**Student Name:** Conor McKeon

**Introduction:** Because of its immersive nature, the study abroad (SA) environment is often assumed to be the ideal context for students of a second language (L2) to acquire or enhance their linguistic and cultural competency. The acquisition of certain pragmatic features would seemingly be inevitable in a SA experience, as pragmatics is a contextual unification of language and culture. Our research assesses the impact of pragmatic instruction designed to enhance the usage and understanding of apologies made by students who participate in a Marquette short-term study abroad program. The study will be carried out by exposing students to pragmatic instruction regarding the appropriateness and usage of apologies in Spanish to provide greater contextual awareness of this difficult to acquire speech act.

**Significance:** Pragmatics addresses the contextually appropriate use of language. L2 pragmatic development has been a pertinent topic of study in SA research in recent years. However, little research has been conducted on the effects of short-term study abroad programming as it relates to pragmatic acquisition. Learning the pragmatic norms of the host community can be considered high stakes for SA students, as there are direct and real-life consequences that may facilitate or hinder their interactions and interpersonal relationships while abroad.

**Innovation/Forward Thinking:** Our research assesses the pragmatic appropriateness of student apologies using oral discourse completion tasks (DCT) consisting of five vignettes that vary across three variables: relative social status of the interlocutor, relative social distance, and seriousness of the offense. The researchers will develop an interactive animation tool, known as Computer Animated Production Task (CAPT) for pre-test and post-test data collection and assessment. Further, students' cognition or perceptions about sociocultural factors that impact speech act performance will be assessed through retrospective verbal reports.

**Student Involvement:** Our research grew out of Conor McKeon's participation at a graduate level Second Language Acquisition course in Spring 2017 taught by Dr. Todd A. Hernandez, Ph.D. Conor's duties will include: recruiting participants; designing the intervention; transcribing and coding data; co-presenting at a research conference; and co-authoring an article.

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**Keywords:** Second language acquisition, pragmatics, study abroad, apologies

**Project Title: The Relationship between Conservative Ideologies and Support for Hilary Clinton and Donald Trump during the 2016 Presidential Election.**

**Faculty Name:** Simon Howard, Assistant Professor, Psychology

**Student Name:** Bridget Trimble

**Introduction:** We designed a survey to answer the question: How do conservative ideologies influence attitudes and decision making in the context of politics, specifically voting behavior. Essentially, we hypothesized, individuals who score higher on a Gender-related System Justification (GSJ) scale or Social Dominance Orientation (SDO) scale, than you are more likely they would vote for Trump versus Hilary Clinton in the 2016.

**Significance:** This research attempts to demonstrate that "bottom up" psychological processes may influence voting preferences and intentions. It is commonplace for behavioral scientists to argue that voting behavior is influenced by top-down such as political advertising, media coverage, and other institutional factors, however other research has demonstrated how ideology may also influence behavior. This work will investigate if ideologies justifying gender inequality predict the ways in which people intended to vote in the 2016 election. Our results will have implications for future elections, particularly when a female candidate is running for positions/roles that have historically been reserved for men (e.g., Presidency).

**Innovation/Forward Thinking:** This work is innovative because we are looking at how bottom up vs top down processes influence voting preferences and voting intentions.

**Student Involvement:** As an RA, I reviewed similar experiments in order to find a meaningful relationship between our project and real life issues that need to be further addressed and analyzed. This research also gave me a better understanding of the various theories exemplified in our experiment.

**Project Title: The Relationship between Feminine Identification and voting intentions for Hilary Clinton/Donald Trump during the 2016 Presidential Election**

**Faculty Name:** Simon Howard, Assistant Professor, Psychology

**Student Name:** Hannah Mascio, Kalen Kennedy

**Introduction:** This project aims to answer the question: What is the relationship between collective female identification and voting intentions for Hilary Clinton? We are exploring how gender identification can influence support for candidates.

**Significance:** Past research shows that gender identification may not be directly related to political affiliation, but it can help predict which way a person is likely to vote. Gender identification of candidates has also shown how voters view the candidates. There is a tendency to view women as fragile or weak which can negatively affect their ability to be elected for a powerful position. By researching this topic further, we will be able to add to the understanding of what influences a voter and how campaigns can be changed to reflect the ideals of their target voters and the ways in which people view women in elected offices.

**Innovation/Forward Thinking:** This project is innovative because it is working towards understanding the relationship between collective female identification and voting intentions. We are looking at different factors that influence the way in which people vote which can help future female candidates run more successful campaigns.

**Student Involvement:** As a Research Assistant for this project I have been reviewing other experiments that are similar to this. I was looking for how previous research could relate to our project, how we could learn from what has been done, and what areas of the topic need to be further explored.

**Project Title: Beyond Ramen: College Students' Experiences with Food Insecurity****Faculty Name:** Jody Jessup-Anger, Associate Professor, Educational Policy and Leadership**Student Name:** Noreen Siddiqui

**Introduction:** Food insecurity (FI) among college students has recently gained national attention as research increasingly indicates that this is a problem effecting 1 in 5 students.<sup>1,3</sup> Despite being a newly recognized problem in higher education, the research so far has shown that FI negatively impacts students academically, socially, mentally, and physically.<sup>1,2,3</sup> Some authors have speculated, without supporting evidence, that students' irresponsibility is to blame for their FI.<sup>3</sup> The majority of research on campus FI relies on surveys and focuses on quantifying the extent of the problem and finding correlations between student characteristics. Only a few studies have utilized an interpretive approach.<sup>2</sup> The purpose of this proposed study is to gain insight into the lived experiences of food insecure college students. Using a qualitative approach, this study will compare FI experiences across different university types. The study will highlight students' skills through coping strategies rather than strengthen enduring stereotypes about poverty. It seeks to answer the following research questions:

1. How do students who are food insecure while in college describe their lived experience?
2. What coping strategies do students utilize to address their food insecurity?
3. How are these experiences and strategies shaped by the institutions they attend?

At least 30 food insecure students who currently attend one of three universities located in Milwaukee, Wisconsin will be interviewed. Marquette University (MU) is a mid-sized Catholic research-intensive school. Mount Mary University (MMU) is a small Catholic women's institution that serves many first-generation, low-income students. The third school, University of Wisconsin – Milwaukee, is a public research-institution. The three sites were chosen because of the variation in institutional type in order to examine whether institutional differences effect students' experiences of FI. A minimum of 10 students will be interviewed from each school until saturation of the data is reached.

**Significance:** This study would enhance the existing campus FI literature by adding to the mostly absent research on private universities, giving voice to students from a variety of institutional types about their lived experiences, and investigating how institutional characteristics shape students' experiences and strategies for coping with FI. It will also add to the literature by utilizing an asset-based approach to food insecure students, as opposed to a deficit-based approach that blames students for their FI.

**Innovation/Forward Thinking:** The preliminary research conducted by Noreen Siddiqui for this project has already led to work being done on two campuses to address issues of student food insecurity. This study has the potential to better inform these and other interventions to support food insecure students.

**Student Involvement:** This research project will be led by Noreen Siddiqui, a doctoral student in Educational Policy and Leadership, under the guidance of Dr. Jody Jessup-Anger.

**References:** 1. Bruening, M., Brennhofner, S., van Woerden, I., Todd, M., & Laska, M. (2016). Factors related to the high rates of food insecurity among diverse, urban college freshmen. *Journal of the Academy of Nutrition & Dietetics*, 116(9), 1450-1457.,

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**Keywords:** College students, Food insecurity, Institutional types, Coping strategies

**Project Title: A Swimming Program for children with Autism Spectrum Disorder: Impact on Child Challenging Behaviors and Caregiver's Psychological Well being**

**Faculty Name:** Norah Johnson, Associate Professor, College of Nursing

**Student Name:** Veronica Nakhla

**Introduction:** Autism Spectrum Disorder (ASD) is a lifelong neurodevelopmental condition that impacts child socialization, communication, and behaviors, affecting 1/59 people in the United States. ASD impacts not only children but also their caregivers/parents' physical and psychological well-being. Swimming benefits children with Autism Spectrum Disorder as it impacts a child's challenging behaviors, social behaviors and improves their overall physical well-being. Aquatic activity is a whole-body exercise that can impact child stress level, muscle tone, endurance, weight management, and over all physical and psychological well-being.

**Significance:** Research shows that drowning is a leading cause of death in children with ASD. According to the National Autism Association, accidental drowning accounted for 90 percent of total U.S. deaths reported in children with ASD ages 14 and younger between 2009 and 2011.

**Innovation/Forward Thinking:** The purpose of this study is to (1) assess baseline child challenging behaviors for children with ASD from the caregiver perspective, (2) Assess caregivers baseline state anxiety, positive thinking, and psychological well-being, (3) Provide a swimming program of 12 sessions (one hour per session) for children with ASD to teach them how to swim, and to teach caregivers precautions for safety around water, (4) Use mixed methods to assess post swimming program intervention parameters as well as changes in child behavior and caregiver psychological constructs. This research will provide a firm foundation for developing a proposal for a larger clinical trial and receipt of federal funding.

**Student Involvement:** The student will be involved in the literature search and the post swimming program intervention parameters including the child behavior and caregiver psychological constructs.

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**Keywords:** Autism spectrum disorder, Swimming, Physical well-being, Psychological well-being

**Project Title: Mechanism of Mechanical Vibration in Regenerating Alveolar Bone in Experimental Periodontitis****Faculty Name:** Dawei Liu, DDS MS PhD, Associate Professor, Dentistry**Student Name:** Shiloh Golden, DDS

**Introduction:** In the United States one out of every two adults age 30 or older – 64.7 million American adults - has periodontal disease. In adults 65 and older, the prevalence increases to 70.1 percent (Eke PI, *et al*). Periodontal disease is a chronic inflammatory disease which affects gum tissue and alveolar tooth-supporting bone, which if left untreated, can lead to tooth loss (American Academy of Periodontics) and have an adverse impact on clinical dentistry, including the stability of removable prostheses and success of dental implants (Alikhani, M. *et al*, 2012). Periodontitis also exerts an adverse impact on systemic health and has been associated with other chronic inflammatory diseases such as diabetes and cardiovascular disease. Many surgical techniques used in treating bone loss in periodontitis, such as implantation of various types of bone graft and/or bone substitutes, among others, have been shown to be effective for treatment of alveolar bone loss, but are also expensive, invasive and associated with significant morbidity, especially in older adults. Studies have shown that high frequency mechanical vibration has anabolic effects on bone mass and architecture. For example, Honda *et al* (2001) demonstrated the positive anabolic effects of exercise and loading on weight-bearing bones. However, no knowledge is available on the effects of mechanical vibration on the regeneration of alveolar bone in periodontitis. Therefore, in this project we are going to establish a mouse periodontitis model and investigate whether mechanical vibration helps regenerate alveolar bone in experimental periodontitis.

**Significance:** Tooth loss is a significant consequence of periodontal disease/alveolar bone loss that can significantly reduce Oral Health-Related Quality of Life (OHRQoL) in affected patients (Gerritsen, AE. *et al*. 2010). Some studies have demonstrated that having 9 or less teeth reduces the physical index of quality of life to the same extent as cancer or renal disease (Mack, F. *et al*, 2005). The combination of surgical and pharmaceutical treatments for the regeneration of alveolar bone have been suggested, but are often invasive, costly, and have application limited to small regions of bone loss. Thus, a significant demand exists for an effective, non-invasive, and safe treatment for alveolar bone loss in order to address this emerging public health concern and help to maintain the overall health and well-being of an aging population.

**Innovation/Forward Thinking:** To the best of our knowledge, we are the first to study the effect of mechanical vibration on alveolar bone regeneration in an experimental periodontitis model. This project aims to uncover the effects of mechanical vibration on bone formation and potentially provide us an opportunity to apply mechanical vibration to help regenerate alveolar bone in patients affected by periodontitis.

**Student Involvement:** Shiloh Golden, a 1<sup>st</sup> year orthodontic resident at Marquette University School of Dentistry will fully participate in this project. He will completely be involved in designing and implementing experiments, analyzing data and writing research paper.

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**Project Title: Effects of Mechanical Vibration on Osteointegration in Vitro****Faculty Name:** Dawei Liu, DDS MS PhD, Associate Professor, Dentistry**Student Name:** Tara Groen DDS, Kirstin Karkow DDS

**Introduction:** Today dental implants are commonly used in rehabilitating oral functions of patients with missing teeth. The fundamental principle of dental implants is called osseointegration – a process of direct structural and functional connection between living bone and the surface of a load-bearing artificial implant. Osseointegration is very critical in determining the long-term success of dental implants, which is influenced by many factors including mechanics. Mechanical vibration has been shown to be anabolic (promoting osteoblastic bone formation) in enhancing bone modeling process e.g. fractures. Recently, whole body vibration has been shown to increase bone formation around implants in diabetic rats (1). Although proposed as an idea (2), so far there is no data showing the enhancement of osseointegration of dental implants by mechanical vibration. Therefore, it is logical to study the effects of mechanical vibration on the osteogenic potential of the osteoblasts cultured on the dental implant material surface. Our hypothesis is that mechanical vibration enhances proliferation and differentiation of osteoblasts cultured on dental implant material surface. If our hypothesis is proved, mechanical vibration can potentially be applied clinically to enhance osseointegration of dental implants, which will eventually promote the success and longevity of dental implants for patients.

**Significance:** Without knowing whether mechanical vibration promotes proliferation and differentiation of osteoblasts cultured on dental material surface, it is impossible to provide scientific evidence based on which mechanical vibration can potentially be applied to promote the success and longevity of dental implants. In this study, MC3T3-E1 pre-osteoblasts will be seeded at a density of  $4 \times 10^5$ /well on the discs of dental implant material (to be provided by Straumann Inc.) in 12-well cell culture dishes. The cells will be subjected to mechanical vibration (0.3g, at 0, 30, 60 and 90 Hz respectively) or kept under static culture condition without vibration as control. The cells will be vibrated 1 hour a day for consecutive 14 days. Cell proliferation will be assessed on day 0, 3, 5, 7, 14 by using MTT method. While differentiation will be examined by day 14 using van Kossa staining. One-way ANOVA will be used to compare the differences of each parameter between the vibrated and the non-vibrated groups, with Tukey comparison to be used to find out the difference between various frequencies. P value less than 0.05 is considered statistically significant.

**Innovation/Forward Thinking:** To the best of our knowledge, no studies have been reported on the effect of mechanical vibration on osteoblasts cultured on dental implant material surface. This project aims to explore the effects of mechanical vibration on proliferation and differentiation of osteoblasts cultured on dental implant material surface, which will provide scientific evidence for us to potentially use mechanical vibration to enhance osseointegration in dental patients.

**Student Involvement:** Tara Groen DDS, Kirstin Karkow DDS (1<sup>st</sup> orthodontic residents) will participate in this project. They will be involved in designing and implementing experiments, analyzing data and writing research paper.

**References:**

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2. Zhao L et al. *Med Hypotheses*. 2009; 72(4):451-2.

**Project Title: Mechanism of Mechanical Vibration in Enhancing Orthodontic Retention – A cellular and molecular approach**

**Faculty Name:** Dawei Liu, DDS MS PhD, Associate Professor, Dentistry

**Student Name:** Joshua Murphy DDS and Jared Holloway DDS

**Introduction:** Orthodontic tooth movement (OTM) is a mechanically induced modeling and remodeling process of periodontium (gingiva, periodontal ligament (PDL) and alveolar bone), which is mediated by many pro-inflammatory factors e.g. PGE<sub>2</sub> and cytokines e.g. IL-1 $\beta$ , IL-6, TNF- $\alpha$  (1). Low-magnitude high-frequency (LMHF) has been shown to be anabolic and used as a non-invasive anti-resorptive means to manage bone loss conditions such as osteoporosis. In dentistry, mechanical vibration has been shown to be able to increase alveolar bone mass and maintain bone mass after tooth extraction in mice. To explore the effects of mechanical vibration on alveolar bone recovery during orthodontic retention, we established an orthodontic retention mouse model, and found that mechanical vibration helps regenerate bone volume during orthodontic retention in mice. To unveil the mechanism behind this phenomenon, we in this study will generate an orthodontic retention cell culture model and apply mechanical vibration (0.3g and 30, 60 and 90 Hz respectively) to human PDL cells after orthodontic loading in vitro.

**Significance:** The effects of low-magnitude mechanical-vibration (at different frequencies) on human PDL cells after orthodontic loading in vitro are unknown. Without knowing its mechanism, there is no way to provide an evidence-based therapy i.e. using mechanical vibration to enhance orthodontic retention, for example, at what frequency and for how long should vibration be used for the patients. In this study, human PDL cells will be seeded at a density of  $4 \times 10^5$ /well in 6-well culture plates (Day 0). After overnight culture, the cells will be randomly assigned to 4 groups: 1) control (N=3), 2) post orthodontic loading (N=3), 3) vibration (N=3), and 4) “post orthodontic loading + vibration” (N=3). Prior to vibration, the cell culture medium will be changed to differentiation medium, and then subject the cells in groups 3 and 4 to mechanical vibration (0.3g) at three frequencies (30, 60 and 90Hz respectively), while taking the static cells (0Hz) as control. The vibration will be applied for 1 hour a day for 14 consecutive days. Before the start and end of vibration, the concentrations of two key inflammatory factors - PGE<sub>2</sub> and IL-1beta in the supernatants of the cultured cells will be collected and measured by ELISA. By the end of the experiment, bone nodule formation will be assayed. One-way ANOVA with Tukey *post-hoc* comparison will be used to find the difference among the experimental groups with p value being set at 0.05.

**Innovation/Forward Thinking:** To the best of our knowledge, we are the first to look into the mechanism of the effects of mechanical vibration on orthodontic retention at a cellular level using an orthodontic retention cell culture model. This project aims to uncover the frequency-specific effects of mechanical vibration on human PDL cells differentiation using orthodontic retention cell culture model.

**Student Involvement:** Joshua Murphy DDS and Jared Holloway DDS (1<sup>st</sup> year orthodontic residents) will fully participate in this project. They will completely be involved in designing and implementing experiments, analyzing data and writing research paper.

**References:**

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**Project Title: Predictive Model of Protein Expression Level Using Machine Learned Genetic Features (SNPs)****Faculty Name:** Mehdi Maadooliat, Assistant Professor, Mathematics, Statistics, and Computer Science**Student Name:** Paromita Nitu

**Introduction:** Human genetic structure is responsible for numerous diseases (Manolio et al., 2009). Studying structure and function of proteins can explain many of the rudimentary causes of different genetic diseases such as psoriasis, cardiovascular disease, rheumatoid arthritis, diabetes, obesity, hematopoietic cancers, systemic lupus erythematosus etc. Since, protein abundance plays an essential role in regulation of body tissue and organs, any dysfunctional in protein regulation is potentially an indicative cause of disease states. Further, protein regulation is partially driven by effects of genetic variants. Thus, to understand the genotype-phenotype correlation patterns, investigating protein concentration levels (pQTLs- protein quantitative trait loci) as intermediate endpoint for clinical disease states seems a reasonable avenue of investigation. Identifying genetic variants associated with pQTLs may illuminate the proteome's causal role in diseases.

**Significance:** A large-scale study of the impact of functional variants/protein levels provides influential insights into complex disease traits [1,3]. In this study, I will examine the evidence of association between distinct genetic variants and protein expression levels. This approach has been fruitful in other populations. For example, genome sequencing of samples from Sardinia has helped elucidate the impact of genetic variants on lipid levels and five inflammatory biomarkers, revealing new genetic associations [2]. Therefore, investigating pQTLs in quest of new association in the Central Wisconsin population seems highly advantageous [2,4].

**Innovation/Forward Thinking:** For this research project, we are interested to dig deeper into the Marshfield clinic primary dataset with regard to protein expression and genotype data. An initial data cleanup has been performed to suppress any potential confounding due to non-systemic factors such as diseases due to acute infection, vaccination etc. Investigating any association between genetic variant and protein levels may help us reveal significant findings for complex traits and risk of disease in humans. The dataset consists of 1015 samples from discovery phase and 1000 samples from a replication phase, obtained from the Personalized Medicine Research Project. Sample data consist of protein specific normalize concentration measures as well as measurement of genome-wide single nucleotide polymorphisms (SNPs).

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**Project Title: MaLaBiDATS: Machine Learning and Big Data Application Trust Scoring**

**Faculty Name:** Praveen Madiraju, Associate Professor, Mathematics, Statistics, and Computer Science

**Student Name:** Joseph Coelho

**Introduction:** Big Data refers to data that is characterized by volume, velocity, variety, veracity and value. Big Data and algorithms have given rise to a new method of doing science: Data Science. This newfound resource has found its way into diverse applications. Machine Learning refers to the ability of computers to learn from data by observing patterns that occur and then extrapolating its findings to new data. This "predictive" ability of machines has ethical consequences due to various factors that come into play in such operations. Computer scientists are generally concerned with issues like confidentiality, integrity, and availability (CIA triad). However, in data science the issues are more complex. Seemingly "innocent" data itself can be called into question. An improper choice of algorithms can have an undesired effect unknown to the user. Assumptions made in the creation of the application can unconsciously lead to a design that is not fair. The ProPublica report (Angwin, 2016) is one of many that have shown how bias and discrimination is quite possible in machine learning and big data based applications.

**Significance:** Big Data and Machine Learning applications are quite ubiquitous today. Job recruitment, student advising, banking, court sentencing, housing, are some areas where machine learning plays a role in determining outcomes. Sometimes these outcomes can result in issues like inconclusive evidence (unjustified actions), inscrutable evidence (opacity), misguided evidence (bias), unfair outcomes (discrimination), transformative effects (challenges for autonomy and privacy), and traceability (moral responsibility). Bias can also come into play through the choices made by those developing the applications: choices regarding data, feature selection, and algorithm used. Whenever bias exists, there will be discrimination. The goal of any big data / machine learning application should be to produce fair outcomes rather than merely accurate ones. When applications are non-discriminatory their value increases and they can be trusted. A metric to measure trustworthiness of an application is invaluable. Significant work has been done to develop fairness-aware algorithms that reduce discrimination. This project seeks to develop a metric to measure "trustworthiness" of machine learning applications based on features that have a direct bearing on bias in its various forms and suggest auto-correcting ways to make them fair.

**Innovation/Forward Thinking:** Machine learning and big data are the cornerstone of data science and of many applications today. Proving a metric to measure the trustworthiness of an application would help users to interact more freely with the application.

**Student Involvement:** The first part will involve defining bias, trust, discrimination, and fairness. The second part will identify the various forms of bias in machine learning applications. The third part will develop auto-correcting ways to minimize bias. The fourth part will consist in developing a metric to measure "trust".

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**Project Title: Humor Recognition****Faculty Name:** Praveen Madiraju, Associate Professor, Mathematics, Statistics, and Computer Science**Student Name:** Priyanka Annapureddy, Paromita Nitu

**Introduction:** Humor is an important aspect in human communication, incorporating humor in conversations improves social connectivity and the activity of those using it. There is increasing volume of humorous texts growing in social media, identifying and understanding humor in those texts can help in understanding the user mood prediction and sentiment analysis on social media. Humor can be in either verbal or non-verbal form. Because of the growing use of computers for communication and work, studies on computational humor have taken importance. Computational humor is more concerned with automatic recognition, understanding and generation of humor. Sometimes it is difficult even for the human beings to understand humor because it varies with the cultural context and different people make different understanding of the same sentence. Thus, automatically recognizing humor in a text is a challenge. Today, in many applications chatbots are evolving as conversational interfaces. If a computer can identify humor when it converses with a human being and understand human intentions it can improve the human-machine interactions and improve the customer experience.

**Significance:** Users are actively participating in social media platforms to share their opinions and reviews on products, topics etc. Some can express their opinion in a humorous way and some tweets may be tagged as humor but may not be humorous. It is important to recognize the humorous tweets and understand the opinion of the user. There are some studies on humor recognition on twitter but to the best of our knowledge there is none which can distinguish humorous and non-humorous tweets and analyze the opinion of the user. Our work aims to not only recognize humor in a tweet but also identify the opinion of the user.

**Innovation/Forward Thinking:** Twitter has hundreds of millions of messages being posted daily and the language or style used in tweets could be informal as compared to other texts. This makes it more challenging to classify the tweets. We plan to collect the tweets from comedian accounts and the tweets tagged as '#humor', however not all those tweets can be directly considered as humorous tweets, some of them could be plain tweets. Manual verification of the tweets and categorizing them as humorous or non-humorous for training the model is required. This work aims at using classification algorithms and other Natural Language Processing algorithms to identify the features that characterize humor and for opinion mining.

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**Project Title: Identifying Building Accessibility using Image Classification****Faculty Name:** Praveen Madiraju, Associate Professor, Mathematics, Statistics, and Computer Science

Roger Smith, Professor, Occupational Science &amp; Technology

**Student Name:** Wenliang Hu, Joseph Coelho

**Introduction:** The Americans with Disabilities Act (ADA) is a civil rights law that was signed into law in 1992 by President George H.W. Bush. The law requires wheelchair access be made available for buildings built after 1992. Buildings under the law include retail stores, hotels, banks and most other public buildings. However, there are large number of buildings built before 1992 that are not wheelchair accessible. In addition, ADA does not require the location of ramp to be at the front of the building. This is an inconvenience for folks in wheelchair to access a building, as they may have to use wheelchair all the way from the front to back of the building where the ramp may be located. Hence, in this project, we propose to build an artificial intelligent system, which takes as input a building image, and gives as output, if the building has a ramp. The proposed system uses a deep learning technique, convolution neural network (CNN) to classify building images.

**Significance:** A survey (Piekarski, 2017) of 554 Americans with disabilities revealed that, twenty percent of them encounter a barrier to a building, a service or a transportation at least once a day. The problem gets even worse in major cities like New York City and Washington, D.C. The negative impacts of having buildings not be wheelchair accessible or having ramps at inconvenient locations of the buildings, leads to frustration, being left out and ultimately becomes a social injustice to people with disabilities. Knowing if the building is wheelchair accessible and the location of the ramp, before arriving at a location helps plan the trip. As more people find out which buildings are accessible, the system will also help bring awareness to the public and may nudge builders to change their building designs. Hence, our project proposes to alleviate the problem to some extent by classifying a building as accessible based on the building image. The proposed software system will be (i) easy to use by allowing access to the application through a mobile phone or a web browser, (ii) automatic with minimal human intervention, and (iii) provides response quickly.

**Innovation/Forward Thinking:** To the best of our knowledge, we did not find any automatic system or a mobile application, which takes a building image and classifies it for accessibility. We have begun the process of collecting training dataset for our machine-learning model. The dataset consists of building images around Milwaukee area. We also plan to collect a number of building images from google maps. It is important to have a diverse set of images such as coffee shops, libraries, restaurants, university buildings, etc. to build a generic system. We will then evaluate the accuracy of our model.

**Student Involvement:** Wenliang is a Master's student in Computational Sciences program. She is working with Joe Coelho, PhD student in the program under the direction of Dr.Praveen Madiraju, MSCS.

**References:** Piekarski, J.(2017, April). Major American Cities Still Pose Problems for People with Disabilities. Retrieved from <http://blog.disabilitycanhappen.org/american-cities-problems-people-with-disabilities/>, last accessed November 1, 2018.

**Project Title: Region Growing Refinement of semantic segmentation masks****Faculty Name:** Henry Medeiros, Assistant Professor, Electrical and Computer Engineering**Student Name:** Philipe Ambrozio Dias

**Introduction:** The combination of deep learning models known as convolutional neural networks (CNN) and increasingly larger public datasets has led to substantial improvements in image classification. For classification at pixel-level, however, conventional CNNs provide segmentation masks that only coarsely adhere to object boundaries. Moreover, abundant and reliable data are crucial for development of deep learning models, but high-quality annotation of image segmentation datasets usually requires a huge number of hours. We have been developing the Region Growing Refinement (RGR) algorithm, which has the potential to address both issues. RGR is a unsupervised method that employs region growing to aggregate pixels with low confidence levels to its neighboring areas with high confidence scores and similar appearance. The efficacy of RGR for segmentation refinement culminate in the corresponding paper (Dias & Medeiros, 2018).

**Significance:** For applications such as action and activity recognition, fine-grained segmentation is crucial as the interaction between different objects has to be identified. Interactions are characterized by the proximity, contact between agent and object, such that detections with poor adherence to object boundaries can lead to incorrect interpretations of the scene. As for the annotation of image segmentation datasets, manual labeling of large datasets is challenging and timeconsuming. For example, the annotation of the COCO dataset required 55k worker hours for instance segmentation, which makes such processes often prohibitively expensive.

**Innovation/Forward Thinking:** In addition to better theoretical modeling and further improvements of RGR, we have been also developing FreeLabel (Dias, Tabb, & Medeiros, 2018), an intuitive open-source web interface based on RGR that allows users to obtain high-quality segmentation masks with just a few freehand scribbles, in a matter of seconds. To benefit the computer vision community, we design FreeLabel such that it can be used for both crowdsourced or private annotation, with a modular structure that can be easily adapted for any image dataset.

**Student Involvement:** Dr. Henry Medeiros directs the research project. Philipe Dias works on development and evaluation of the RGR algorithm. Zhou Shen works on implementation of the FreeLabel interface.

**References:** Dias, P. A., & Medeiros, H. (2018). Semantic Segmentation Refinement by Monte Carlo Region Growing of High Confidence Detections. In Asian conference on computer vision.,  
Dias, P. A., Tabb, A., & Medeiros, H. (2018). FreeLabel: A Publicly Available Annotation Tool based on Freehand Traces. In IEEE Winter Conference on Applications of Computer Vision (under review).

**Keywords:** Segmentation refinement, Deep Learning, Image annotation

**Project Title: Dynamic Performance Measurement of Mobile Manipulators****Faculty Name:** Henry Medeiros, Assistant Professor, Electrical and Computer Engineering**Student Name:** Reza Jalil Mozhdehi

**Introduction:** Mobile manipulators are a potential solution to the increasing need for additional flexibility and mobility in industrial applications. However, they tend to lack the accuracy and precision, especially in scenarios where both the manipulator and the autonomous vehicle move simultaneously. Previous attempts at solving this problem have used deterministic approaches such as a spiral search around the expected location of the end-effector with the platform stationary. We propose the use of stochastic methods to improve search performance in locating a group of retroreflective markers.

**Significance:** Flexible robotic manufacturing systems is particularly important for small and medium enterprises, which do not have the production scale to justify investing heavily in task-specific robotic systems. Mobile robotic manipulators are one important component in the development of the flexible manufacturing systems of the future, but dynamic manipulation is a notoriously challenging task. Hence, the ability to quickly and accurately localize the mobile manipulator with respect to an object of interest in the presence of uncertainty is of relevance not only for the robot calibration and accuracy evaluation but also for the development of robust and efficient sensor-based flexible robotic systems. Our work sets the stage to enable the application of mobile manipulators to a wide array of tasks they are currently suited for but not widely used, for example in the painting or assembly of large structures like aircraft and wind turbines.

**Innovation/Forward Thinking:** In this project funded by National Institute of Standards and Technologies (NIST), we are going to improve the performance of our mobile manipulator mounted on an automated guided vehicle (AGV) [4]. More specifically, we are interested in investigating the scenario in which both the AGV and robot simultaneously move while the robot accesses test points in a known reconfigurable mobile manipulator artifact. A laser sensor is mounted at the end effector in order to localize the markers. The alignment must be done as quickly and as accurately as possible considering the uncertainties in the motion of the robot. We evaluate the performance of a stochastic search algorithms against a deterministic spiral search, in finding the markers. Thus, Bayesian methods to predict the position of the end effector in the presence of uncertainty propagated from the mobile platform. The precision of the mobile manipulator is evaluated through its ability to intercept retroreflective markers using a photoelectric sensor attached to the end-effector. In our initial results, we observed improved robustness with comparable search times, thereby enabling effective calibration of the mobile manipulator in comparison with a deterministic search approach [4]. However, we need to improve the performance of our algorithm in higher speeds and implement automatically initializing which then allow us to run many more experiments and generate more results. In the next step, other searching methods such as the rejection sampling is examined.

**Student Involvement:** Reza Jalil Mozhdehi as a PhD candidate is implementing these contributions. The project is under supervision of Dr. Henry Medeiros.

**References:** S. Y. Amoako-Frimpong, M. Messina, H. Medeiros, J. Marvel, and R. Bostelman, "Stochastic Search Methods for Mobile Manipulators," in International Conference in Flexible Automation and Intelligent Manufacturing (FAIM), 2018.

**Keywords:** Mobile Manipulators, Automated Guided Vehicle, Deterministic Search, Stochastic Search

**Project Title: Visual Tracking: Deep Convolutional Iterative Particle Filter with Multiple Correlation Models**

**Faculty Name:** Henry Medeiros, Assistant Professor, Electrical and Computer Engineering

**Student Name:** Reza Jalil Mozhdehi

**Introduction:** Visual Tracking refers to automatically following a specific target even under challenging scenarios such as fast target motion, occlusion and deformation in a video. Recently, machine learning methods have been successfully employed in tracking algorithms to improve their performance. Thus, we have focused on different methods of machine learning in the context of visual tracking.

**Significance:** Recent breakthroughs in machine learning is resulting dramatic technological shifts in many areas. Most of the new deep learning methods that are being applied in these fields were originally developed by computer vision researchers, and hence the state of the art in this area is still being pushed by researchers. Visual Tracking is one of most important fields of computer vision. It has significant applications in many fields such as robotics, surveillance, autonomous driving, automation, medicine, and Unmanned Aerial Vehicles. However, there is no tracker to be successful in all challenging scenarios such as occlusion, deformation and out of view. So, it is an interesting area for all computer vision researchers to propose new trackers.

**Innovation/Forward Thinking:** In this project, we are going to improve our previous visual trackers. Our first tracker (DCPF) integrates a deep convolutional neural network (CNN) with a particle filter and a correlation filter [3]. After extracting target features for each particle from the CNN, they are compared with the correlation model to estimate target positions. Our second tracker (DCPF2) extends the particle filter to estimate target size and generates several correlation models based on all high-likelihood particles to account for potential errors in the model generation [4]. In our new tracker (DCPF3), we use an iterative particle filter, which helps particles to correct themselves and converge to the true target position so that the most relevant particles are reused. Also, our new tracker generates many more correlation models to improve the accuracy in the correlation filter. Another contribution of our new tracker is to define a confidence score for each frame. According to these confidence scores, three different tracker states are considered: target-found, partially-lost and fully-lost. For each state, different strategies are then applied to generate the correlation models. In the next step, we will work on dynamically extracting the target features from different CNN layers and automatically tuning the thresholds of our algorithm. Finally, we will test DCPF3 on some famous benchmarks such as OTB100 and VOT2016.

**Student Involvement:** Reza Jalil Mozhdehi as a PhD candidate is implementing these contributions. The project is under supervision of Dr. Henry Medeiros.

**References:** R. J. Mozhdehi and H. Medeiros, "Deep convolutional particle filter for visual tracking," in IEEE International Conference on Image Processing (ICIP), 2017.,  
R. J. Mozhdehi, Y. Reznichenko, A. Siddique, and H. Medeiros, "Deep convolutional particle filter with adaptive correlation maps for visual tracking," in IEEE International Conference on Image Processing (ICIP), 2018.

**Keywords:** Convolutional Neural Network, Particle Filter, Correlation Models, Correlation Models

**Project Title: Tracking Passengers and Dive****Faculty Name:** Henry Medeiros, Assistant Professor, Electrical and Computer Engineering**Student Name:** Abubakar Siddique

**Introduction:** Automated video surveillance is defined as detection, tracking, and reconstruction of the objects in a scene. Accurate and precise surveillance in overhead crowded scenes is one of the biggest challenges in computer vision applications. The research goal of this project is to use state-of-the-art deep learning algorithms to detect and track the passengers and their divested items at airport security checkpoints. The perspective distortion degrades the objects recognition, but our approach uses test-time data augmentation with geometric transformation and clustering technique in detection algorithm (He, et.al., 2017) which improve the detection rate. We fine tune multiple hypothesis tracking (Kim, et.al., 2015) approach using appearance and motion features from our improved detection algorithm to get promising multi-object trajectories. The trajectories are then used to detect the events in divestiture and retrieval areas of the checkpoints. However, we still must address the challenges of unfamiliar object detections such as Transportation Security Officers, Crew-members, Toddlers, Wheel Chairs, Service Animals, Pets, and association of the tracked entities such as family unit, divested items, items left behind the scene.

**Significance:** The results of this research project will be used to create a tool for the Department of Homeland Security to enhance safety not only at airport checkpoints, but also on crowded scenes such as rail stations, bus stations, and shopping malls. This project is also useful for identifying abnormal activities by using data association in the challenging crowded scenes such as detecting divested items left behind or theft.

**Innovation/Forward Thinking:** Detecting people and their divested items in overhead camera scenes using deep learning algorithms and refining these detections by using geometric transformation as test-time data augmentation, novel in computer vision research. In addition, the fusion of detection and semantic segmentation results from parallel models can augment the consistency in tracking for multiple camera networks. So, this approach of combining multiple parallel models can be used to accumulate the detections from multiple cameras and use geometric constraints of the multi-camera projection to discard the partial detections.

**Student Involvement:** This research project is under the guidance of Dr. Henry Medeiros and conducted by the student Abubakar Siddique, who is researching the different state-of-the-art methods in computer vision. These methods are primarily used on an airport checkpoint dataset which is recorded by the Kostas Research Institute (KRI) lab at Northeastern University using twenty overhead cameras.

**References:** Chanh Kim, Fuxin Li, Arridhana Ciptadi, James M. Rehg, (2015), "Multiple Hypothesis Tracking Revisited". In ICCV.,  
K. He, G. Gkioxari, P. Dollr, and R. Girshick, (2017), "Mask R-CNN". In ICCV.

**Project Title: Aerial Imaging Riverflow System using Optical Flow****Faculty Name:** Henry Medeiros, Assistant Professor, Electrical and Computer Engineering**Student Name:** Jamir Shariar Jyoti

**Introduction:** Measuring river velocimetry using computer vision techniques is a very new research topic. Conventional river flow measurements consist of meter-based or doppler-based approaches. Although their accuracy is high they are expensive, time consuming and require on-site presence, which in some cases is impossible specially if there is a heavy flood. Several image based river velocimetry techniques have been proposed such as LSPIV (large-scale particle image velocimetry) (Fujita, Muste, & Kruger, 1998). But there are many limitations to these methods for example the flow has to be well-seeded.

**Significance:** Measuring the river velocimetry is important to determine the impact of river flow on water quality such as how it affects the amount of silt and sediment carried by the stream. It is also important to determine the impact on the living organisms and habitats in the stream. During heavy streams aerial imaging riverflow can be a great help.

**Innovation/Forward Thinking:** A new physics based method has been proposed earlier named optical flow, which is derived from scalar transport equation to measure river velocimetry (Khalid, Panard, & Mamin, 2017). We used Flownet 2 (Ilg et al., 2017), an optical flow evaluation network to estimate the flow field of the river flow images. We got our preliminary results. Our next approach is to improve the results compared to the previous results and reduce the noise level of the images so that we can have a better estimation of the flow. Once we have sufficient amount of optical flow images of river flow, we can use a supervised machine learning algorithm to predict the output of the flow based on the input images of river flow.

**Student Involvement:** Dr. Henry Medeiros directs the research project. Jamir Shariar Jyoti works on implementation and evaluation of optical flow and machine learning algorithm for river velocimetry.

**References:** Fujita, I., Muste, M., & Kruger, A. (1998). Large-scale particle image velocimetry for flow analysis in hydraulic engineering applications. *Journal of hydraulic Research*, 36 (3), 397– 414.,  
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Khalid, M., Pacnard, L., & Macmin, A. (2017). Application of optical flow for river velocimetry. *2017 IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 6243- 6246.

**Keywords:** Aerial Imaging, River Velocimetry, Optical Flow, Machine Learning

**Project Title: Quantification of Dispersal Patterns of Invasive Insect Species with Unmanned Aerial Vehicles**

**Faculty Name:** Henry Medeiros, Assistant Professor, Electrical and Computer Engineering

**Student Name:** Brian Stumph

**Introduction:** Newly discovered invasive species can have detrimental effects on agriculture when introduced to a new environment. To reduce these effects, entomologists have strived to obtain knowledge about these migration patterns. Current state-of-the-art methods of studying these migration patterns involve a mark-release-recapture technique. This process involves releasing insects back into the environment after each one is marked, and then attempting to recapture them later. This approach results in a very low recapture rate of less than 5%, largely because researchers manually search these large fields for the marked insects. In this paper, we propose an automated system of detecting insects using an unmanned aerial vehicle. This system utilizes ultraviolet lighting technology, digital cameras, and lightweight computer vision algorithms to quickly and accurately detect insects. The data collected with this system will also be used to generate the GPS locations of each detected insect, thereby incorporating spatial information for entomologists to use. The efficiency and precision of this system will provide for a more comprehensive understanding of these invasive insect species migration patterns. Our experimental results demonstrate our system can detect real target insects in robust field conditions with high precision and recall.

**Significance:** The importance of this research project is evident in the fact that the current state-of-the-art method is largely ineffective. With such a small percentage of insects being recaptured in the environment, entomologists are unable to make any certain conclusions from the small data set they have. With our automated and accurate system, we can greatly increase the amount of data entomologists have at their disposal. The speed of the proposed system will also allow for entomologists to make quicker decisions about the dispersal capacities of these insects.

**Innovation/Forward Thinking:** Although using UAVs in agricultural applications has been done before, there are no research publications that involve using UAVs for tracking insect migration patterns. Insect tracking is a very specific and difficult problem to solve with UAV automation, primarily because of the insect's small size. The techniques we use to solve this problem -- such as color thresholding, ultraviolet lighting systems, and watershed segmentation -- are all innovative techniques that are unique to this application.

**Student Involvement:** This project is the focus of the student, Brian Stumph, research thesis. Dr. Henry Medeiros is advising and directing the research project. Brian conducts all experiments and works on developing the system for further improvements.

**Keywords:** UAV, Object Detection, Computer Vision

**Project Title: Video Object Tracking using CNN-based Spatio-Temporal Instance Segmentation**

**Faculty Name:** Henry Medeiros, Assistant Professor, Electrical and Computer Engineering

**Student Name:** Enrico Prampolini

**Introduction:** Instance segmentation refers to the task of providing pixel-level annotation for each object instance in a given image. When performing this task on video sequences, many challenges arise, such as fast motion blur and occlusions. Generating more accurate and temporally consistent object masks is the first step towards the more complex task of tracking those masks over time.

Multiple objects tracking (MOT) in video sequences is a significant problem in Computer Vision. This problem can be decomposed into two main tasks: (1) determining the location and the number of object, which varies in time, and (2) keep track of their identities over time. Recent work in this field has been driven by the tracking-by-detection paradigm, where objects are usually represented by their bounding box. However with this kind of approach, most of the information is not taken into account, e.g. actual object boundaries.

**Significance:** There are many applications that would benefit from better and temporally consistent instance segmentation, such as scene understanding, video editing or social behavior analysis. Also, the ability to track objects considering their boundaries is very important in applications like autonomous driving.

**Innovation/Forward Thinking:** Motivated by the reasons mentioned above, we propose a recursive estimation framework to improve instance segmentation on video sequences, as well as keep track of the masks over time. In particular, we will study how to integrate a state-of-the-art instance segmentation model, namely Mask R-CNN (He et al., 2017), with Recurrent Neural Networks (RNNs). Those models have recently shown their ability to capture spatio-temporal relationship in visual data (Navabi et al., 2018), making possible to learn complex motion models. Combining the output of the two models will generate "temporally consistent" masks and improve performance with difficult scenarios, e.g. partial occlusions, distortions and fast motion blur. Inspired by the work of (Milan et al., 2017) we will further explore RNNs to perform the data association task of linking masks in adjacent frames.

**Student Involvement:** The student will work at this project as part of his Master's Thesis, under the supervision of Dr. Medeiros.

**References:** He, K., Gkioxari, G., Dollar, P., & Girshick, R.B. (2017). Mask R-CNN. 2017 IEEE International Conference on Computer Vision (ICCV), 2980-2988., Milan, A., Rezatofighi, S.H., Dick, A.R., Schindler, K., & Reid, I.D. (2017). Online Multi-target Tracking using Recurrent Neural Networks. AAAI, Nabavi, S.S., Rochan, M., & Wang, Y. (2018). Future Semantic Segmentation with Convolutional LSTM. BMVC.

**Keywords:** deep learning, instance segmentation, recurrent neural networks, multiple object tracking

## **Project Title: Inflammatory Markers and the Epigenetics of Intergenerational Obesity Transfer: A Systematic Review**

**Faculty Name:** Jennifer Ohlendorf, Assistant Professor, College of Nursing

**Student Name:** Nicole Mattson

**Introduction:** Overweight and obesity have reached epidemic proportions in the U.S. population. In 2014, the Centers for Disease Control and Prevention reported that 44.3% of pregnancies in the United States were complicated by excessive maternal weight (Broadney et al., 2017). It is well researched that maternal obesity increases risk of adverse outcomes for the offspring, even lifelong risks (Drake & Reynolds, 2010).

Pregnancy is a state of mild elevations in serum inflammation markers for all women (Christian & Porter, 2014). Obese women, overweight women, and women with excessive gestational weight gain have increased inflammatory factors compared to women of normal weight. During pregnancy, intrauterine exposure to this level of inflammatory factors may be the mechanism by which obesity and cardiometabolic risk is transmitted to the fetus (Christian & Porter, 2014; Drake & Reynolds, 2010).

The purpose of this systematic review is to examine and critically appraise the published evidence regarding intrauterine exposure to maternal inflammatory biomarkers.

**Significance:** No systematic review of the obesity/gestational weight gain exposome and its impact on offspring weight risk has been performed to date. A systematic review of the literature will provide insight to the mechanisms underlying transfer of weight and cardiometabolic risk to the offspring, informing possible future interventions that have the potential to make a significant impact on the health of the next generation.

**Innovation/Forward Thinking:** Guidelines to mitigate the negative consequences associated with maternal obesity and excessive gestational weight gain have been proposed and focus on ideal gestational weight gain and ideal weight at the start of pregnancy (Maffeis & Morandi, 2017). Because nearly 1/3 of women enter pregnancy obese, other ways to mitigate the negative consequences are needed.

By gaining a better understanding of the underlying mechanism of the intergenerational transfer of risk factors to offspring, future research will be able to focus on interventions or prevention strategies to mitigate or eliminate this transfer of risk, improving future lifelong health for offspring.

**Student Involvement:** The PhD student has been involved in all steps of the planning process and will be involved in the review, critical appraisal, and write up of the systematic review.

**References:** Broadney, M. M., Chahal, N., Michels, K. A., McLain, A. C., Ghassabian, A., Lawrence, D. A., & Yeung, E.H. (2017). Impact of parental obesity on neonatal markers of inflammation and immune response. *International Journal of Obesity*, 41, 30-37. doi: 10.1038,

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Maffeis, C. & Morandi, A. (2017). Effect of maternal obesity on foetal growth and metabolic health of the offspring. *Obesity Facts*, 10, 112-117. doi: 10.1159/000456668.

**Keywords:** Obesity, Pregnancy, Inflammation, Offspring

**Project Title: Gendered Disabilities and Milwaukee Muslim Immigrants: Empowering Muslim Women, Health Providers, and Researchers to Understand Stigmatizing Effects of Disabilities and Promote Positive Change**

**Faculty Name:** Enaya Othman, Assistant Professor, Languages, Literatures, and Cultures

**Student Name:** Ellen Garrity

**Introduction:** In many Muslim families, persons with disabilities are often stigmatized, considered a source of shame, a financial burden, or even a curse upon the family. This stigmatization affects women more so: even when they themselves are not disabled, women are considered the primary caregivers of family members with disabilities, a role that can limit women's access to education, healthcare, and employment. For this project, we will use participatory research methods to collect quantitative and qualitative data via written surveys and oral interviews that document the beliefs and perceptions of disability among immigrant Muslim communities in Milwaukee, Wisconsin, paying particular attention to the effects on women and girls.

**Significance:** Our main goals are to: 1) empower Milwaukee's residents who have a disability and their families who are in Muslim communities, especially Muslim women, to share their stories, lead a public reflection on disability, establish support networks, and seek help through a digital archive and face-to-face meetings; and 2) spur a conversation about disability among community members, researchers, and health professionals.

**Innovation/Forward Thinking:** The community digital archive-the centerpiece of our plan-is a website that will provide a safe space for different stakeholders to interact, and a data source for researchers and health professionals. It consists of three parts: 1) sharing: a community-generated, project team-led collection of testimonies; 2) connecting: a discussion board connecting women or families who have a disabled family member to each other and to available resources; and 3) reflecting: a space for blogs, modeling a multi-disciplinary reflection on cultural constructions of disability and Islam. The digital archived combined with community focus group discussions, public events, and connecting the research team with families who have a member with a disability will result in a direct impact and a reduction in stigma of disabilities within the Muslim community.

**Student Involvement:** We recruited eight Marquette students as interviewers and researchers who will be trained on how to explain the project, conduct the interviews, and ask interviewees to sign informed consent forms. Our team, including students and professionals, will collaboratively collect and analyze the data, write newsletters, engage in focus groups and public events discussion that will contribute to the breakdown of barriers for Muslim individuals with disabilities and their families.

**References:** Amer, Mona M., and Joseph D. Hovey. "Anxiety and Depression in a Post-September 11 Sample of Arabs in the USA." *Social Psychiatry and Psychiatric Epidemiology*, vol. 47, no. 3, 2 Feb. 2011, pp. 409–418., doi:10.1007/s00127-011-0341-4.,

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Herzig, B. (2014). *Young Adult American-Born Muslims and Mental Health*, 7. Dearborn, MI and Washington, D.C., Institute for Social Policy and Understanding.

**Keywords:** Muslim, Disabilities, Stigma, Women

**Project Title: Effect of Soot and Radiation models in Prediction of Pollutant Formation from Practical Combustion Scenarios**

**Faculty Name:** Somesh Roy, Assistant Professor, Mechanical Engineering

**Student Name:** Khaled Mosharraf Mukut

**Introduction:** The present study investigates the formation of soot and NO<sub>x</sub> in a high-pressure constant-volume combustion chamber. This work focuses on the effect of thermal radiation and exhaust gas recirculation (EGR) qualitatively and quantitatively. The spray-A case (n-dodecane as fuel) from Engine Combustion Network (ECN)[1] is used as the target condition. Different soot modeling approaches have been considered. A detailed photon Monte Carlo (PMC) solver with line-by-line (LBL) spectral database is used to resolve multiphase radiative heat transfer.

**Significance:** The main objective of this study is to refine the existing deterministic soot models as well as developing a more comprehensive stochastic model to extract more information about the soot aggregates produced in practical combustion devices.

**Innovation/Forward Thinking:** The existing soot models[2,3] use deterministic approach to solve particle evolution in combustion scenarios. Even the detailed models (e.g. MOMIC[3]) use reaction pathways[4,5] which are very case specific and incapable of producing any information regarding the complexity soot structures. Since soot formation is a stochastic process, a stochastic model is capable of producing soot morphology related data. This will help better understand the soot formation behavior in combustion related scenarios.

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**Keywords:** MOMIC, EGR, PMC, Stochastic Soot Model

**Project Title: An efficient Monte Carlo based solver for thermal radiation**

**Faculty Name:** Somesh Roy, Associate Professor, Mechanical Engineering

**Student Name:** Joey Farmer

**Introduction:** Radiative heat transfer is an important mode of heat transfer particularly in high temperature systems such as in combustion. Radiative heat transfer via participating media is a highly nonlocal process with strong nonlinear effects.

**Significance:** Monte Carlo-based solvers, while well-suited for accurate calculation of complex thermal radiation transport problems in participating media, are often deemed computationally unattractive to use in the solution of a real-world problem.

**Innovation/Forward Thinking:** It has been proposed that by using a low-discrepancy sequence (LDS), the convergence rate of an MC solver can be improved. This approach has led to the development of the family of quasi-Monte Carlo (QMC) methods. In this work, Sobols sequence – an LDS generated with a bit-by-bit exclusive-or operator – is used for developing a QMC solver for thermal radiation. Preliminary results for simple radiation problems in participating media show that the QMC-based solver has a better convergence rate over conventional MC-based solver. At the same time, QMC does not add any significant computational overhead. This essentially leads to a lower computational cost to achieve similar error levels from the QMC-based solver than the MC-based solver for thermal radiation.

**Keywords:** Radiation, Combustion, Monte Carlo

**Project Title: Preliminary Results of a Pilot Study Investigating Neural Underpinnings of Emotion Regulation in Trichotillomania**

**Faculty Name:** Douglas Woods, Dean of the Graduate School, Professor, Psychology  
Kristy Nielson, Professor, Psychology

**Student Name:** Jennifer Alexander

**Introduction:** Trichotillomania (TTM) is a highly impairing obsessive-compulsive related disorder demarcated by repetitive hair pulling that (1) results in hair loss and impairment/distress and (2) persists despite attempts to stop (American Psychiatric Association, 2013). While the most efficacious TTM treatments are those derived from the apparently valid emotion regulation (ER) model of TTM (Bloch et al., 2007; McGuire et al., 2014), gains produced from these treatments are typically only transient (Fine et al., 2012; Keuthen et al., 2010, 2012; Twohig & Woods, 2004; Woods, Wetterneck, & Flessner, 2006). Notably, the ER model of TTM is solely based on findings from behavioral and experiential research. Arguably, advancing the ER model of TTM by incorporating information about the neurobiological underpinnings of ER in TTM could lead to needed TTM treatment advancements. In a step towards advancing this model, the present pilot study was designed to test hypotheses about the neural underpinnings of ER in TTM as derived from a neurobiological model of ER (the extended process model of ER [Ochsner & Gross, 2014]). Data for this study are being collected from two adult groups: a TTM group and a healthy control group. As part of this study, all participants are being administered (1) clinician-rated measures assessing diagnostic status, intellectual abilities, and TTM severity and (2) self-report measures of ER abilities/deficits as well as TTM, anxiety, and depression severity. In addition, participants are undergoing resting-state functional magnetic resonance imaging (fMRI) scans.

**Significance:** Results of this study may provide insight into the previously unknown neurobiological mechanisms underlying emotion regulation in trichotillomania. Given that emotion regulation is hypothesized to be a central, maintaining component of this fairly prevalent and highly impairing disorder, such insights may contribute to needed conceptual and treatment advances in trichotillomania.

**Innovation/Forward Thinking:** Following data collection, the TTM and healthy control groups will be compared on intrinsic functional connectivity (IFC) between their amygdalae, insulae, and various prefrontal regions. The relationship between TTM-affected participants' amygdala-insulae-prefrontal IFC and TTM symptomology as well as ER abilities will also be calculated. All analyses will control for participants' anxiety and depression levels. Preliminary results and their implications will be presented at the time of this research forum. Planned next steps for this project will also be discussed.

**Keywords:** Trichotillomania, Emotion Regulation, Resting-state fMRI