Celebrating Graduate Research

GRADUATE RESEARCH INNOVATION EXCHANGE (GRIE)

Annual Graduate Research Poster Celebration

Wednesday, February 12, 2020

Rubin Campus Center, Upper Level

9 am–noon

Business and Social Science • Life Sciences and Bioengineering • Robotics Engineering, Cyberphysical Systems, Electrical and Computer Engineering • Aerospace Engineering, Manufacturing Engineering, Mechanical Engineering, Civil and Environmental Engineering, Fire Protection Engineering

1–4 pm

Mathematical, Chemical, and Physical Sciences • Data Science, Cybersecurity, and Computer Science • Chemical Engineering and Material Sciences

wpi.edu/+gradresearch

WPI

Welcome to the Graduate Research Innovation Exchange

Thank you for joining us for today's Graduate Research Innovation Exchange (GRIE) poster celebration. Since 2006, graduate students have been gathering at this annual event to share their ongoing research with the greater WPI community. GRIE provides MS and PhD candidates a valuable opportunity to receive feedback on their work in progress while also building and nurturing connections with fellow graduate researchers. By immersing themselves in the excitement of a dynamic and dedicated interdisciplinary research community, they come to see their work in new ways and to understand it in a larger context. It is this exchange of ideas, perspectives, and enthusiasm—the raw ingredients of innovation— that gives this event its name.

As you make your way around the Odeum, you will meet more than 160 graduate researchers representing a diversity of disciplines. They have prepared poster presentations that detail the research in which they are engaged, work that is aimed at broadening our understanding of the world around us and making it a better place to live. You will find that they are eager to help you understand the important technological, scientific, and societal challenges they are tackling, to walk you through the methods they are using, to explain the results of their work to date, and to explore the next steps in their journey of discovery.

As you prepare to start your tour of today's Graduate Research Innovation Exchange, here are a few things to keep in mind:

- There are two poster sessions, with different research categories in each:
  9:00 am – 12:00 pm: Business and Social Science; Life Sciences and Bioengineering; Robotics Enginnering, Cyberphysical Systems, Electrical and Computer Engineering; and Aerospace Engineering, Manufacturing Engineering, Mechanical Engineering, Civil and Environmental Engineering, Fire-Protection Engineering

  1:00 pm - 4:00 pm: Mathematical, Chemical, and Physical Sciences; Data Science, Cybersecurity, and Computer Science; and Chemical Engineering and Material Sciences

- No awards will be presented today. Instead, judges will select up to 60 finalists. They will present their posters again from 1:00 to 4:00 p.m. on April 7 in the Odeum, where judges will select the winners.

We hope you can join us then, and that you enjoy meeting our graduate researchers today.

Rory Flinn
Assistant Dean of Graduate Studies

Where to find them…

Morning Session 9:00 am – 12:00 pm

16	Ajit Mohekar
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33	Alicia Howell-Munson
43	Alycia Abbott
5	Amanda Dings
24	Amanda Toledo Barrios
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64	Arsalan Akhter
17	Arvand Navabi
32	Avery Harrison
11	Binod Giri
25	Chao Wang
21	Daniel Ruiz-Cadalso
55	Dayna Mercadante
80	Devdip Sen
60	Diego Vargas Blanco
59	Elizabeth van Zyl
49	Gian Marco Paci
39	Haadi Mombini
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63	Jakub Tomasz Kaminski
40	Javad Norouzi Nia
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20	Jessica Rosewitz
75	Jianan Li
9	Jie Fang
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57	Jocelyn Petitto
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6	Kaoutar Diouri
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48	Kyle Murdock
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46	Megan Mancuso
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28	Mengqiao Yang
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10	Milad Farzad
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50	Mohammed Masrur Rahman
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78	Sean McGovern
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37	Shima Azizi
42	Shimi Zhou
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26	Shuai Wang
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38	Stephen Frimpong-Manso
76	Tsung-Chi Lin
83	Vignesh Manoj Varier
35	Weizhen Qin
23	Xin Tian
22	Yao Shen
65	Yasmina Benkhoui
77	Yecheng Lyu
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61	Ying Zhou
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29	Zhaolong Zhang
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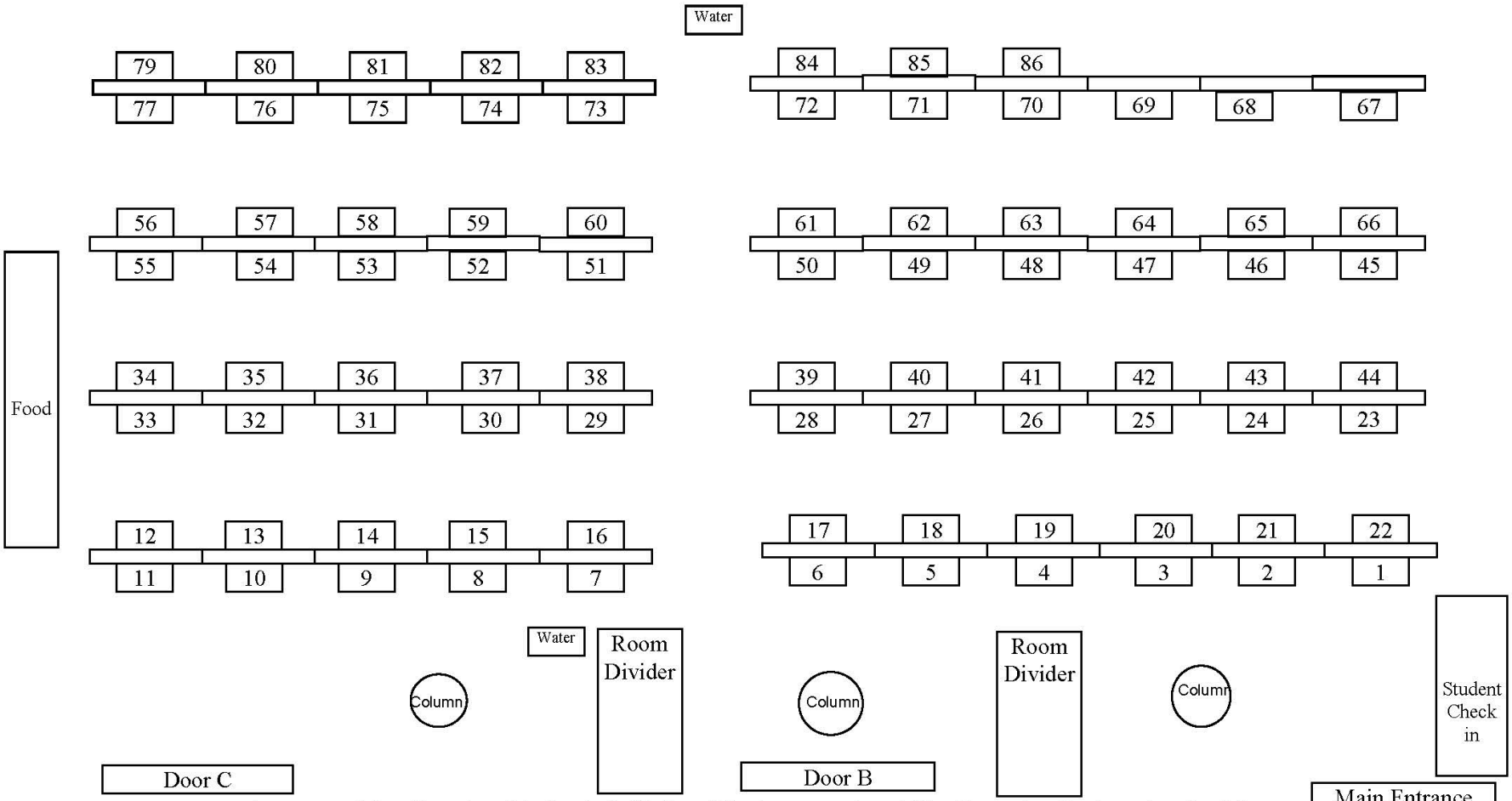
The Odeum

Morning Session



Aerospace, Manufacturing, Mechanical, Civil and Environmental, and Fire-Protection Engineering: 1 – 30

Business and Social Science: 31 – 42

Life Sciences and Bioengineering: 43 – 61

Robotics Engineering, Cyberphysical Systems, Electrical and Computer Engineering: 62 - 86

Where to find them…

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92	Jack Grubbs
121	Tom Hartvigsen
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129	Hamid Mansoor
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135	Ethan Prihar
112	Noelle Rakotondravony
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103	Bryer Sousa
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139	Jidapa Thadajarassiri
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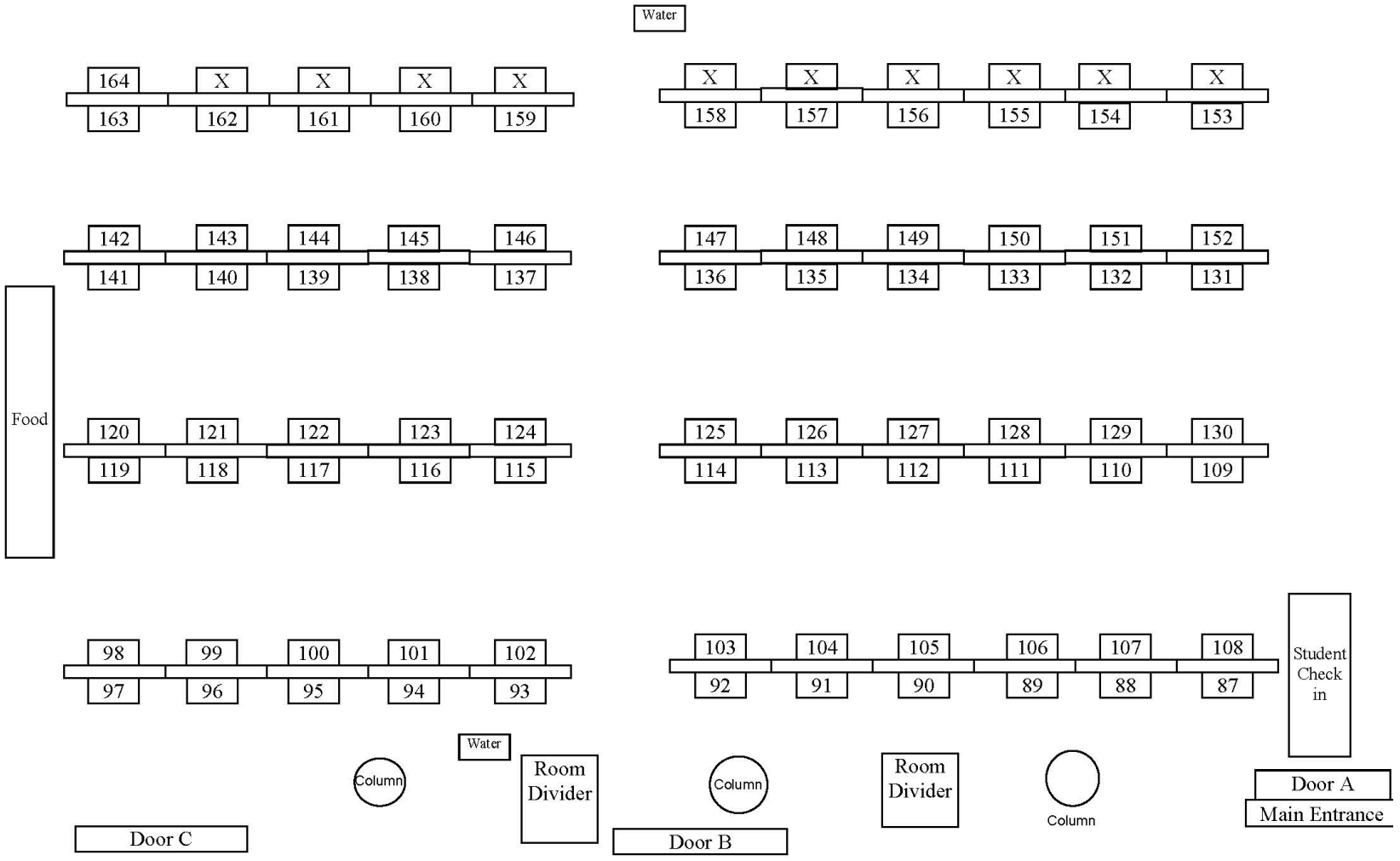
The Odeum

Afternoon Session



Chemical Engineering and Materials Science: 87-111
Mathematical, Chemical, and Physical Sciences: 151-164

Data Science, Cybersecurity, and Computer Science: 112-150

Acknowledgements

Special thanks to…

- Our esteemed panel of volunteer judges comprised of faculty members, alumni, and business experts across a wide range of specialties and fields

- Our hardworking student support team

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  Marketing and Communications
  Printing Services
  Events
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  Facilities
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- The GRIE Planning Committee:

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  Bogdan Vernescu, Vice Provost for Research

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Jagan Srinivasan	Catherine Whittington	

  Rachel Roy, Office of the Provost
  Rory Flinn, Office of Graduate Studies
  Deborah Baron, Office of Graduate Studies

…and, especially, our Graduate Students!

The information presented in the poster sessions or contained in the abstracts for the individual posters is provided solely for the purposes of the Graduate Research Innovation Exchange event and is not intended for general public release.

Aerospace Engineering, Manufacturing Engineering, Mechanical Engineering, Civil and Environmental Engineering, Fire-Protection Engineering

1. **Prajwal Bharadwaj**

Interfacial Damage Evolution in Polymer Bonded Energetic Materials

Department: Mechanical Engineering

Advisor: Nikhil Karanjgaokar

Degree Level: Master's

Keywords: Interface, Damage, Fracture, Optical Imaging, Finite Element Method

Description: Failure at the interface between in a binder-matrix is one of the most common modes of failure in polymer based energetic materials. These types of failure cause accidental detonations by increasing the sensitivity of the energetic material to external loads in its environment. In this research presentation, reinforcing the composite material with carbon nano-particles such as graphene nano-platelets is shown to decrease the sensitivity of the composite to such loading conditions by increasing its resistance to damage initiation at the interface between the two materials.

2. **Alexander Castaneda**

Experimental Study of Flexible Electrohydrodynamic Conduction Pumping for Electronics Cooling

Department: Mechanical Engineering

Advisor: Jamal Castaneda

Degree Level: Ph.D.

Keywords: Electrohydrodynamics, dielectric fluid, electronics cooling, EHD conduction

Description: With modern technology developing at an astonishing rate, electronic devices are becoming smaller, more powerful, and must be able to operate in diverse and extreme environments. In turn, this requires that the thermal control systems that maintain stability in these devices advance in similar fashion. Flexible electrohydrodynamic (EHD) conduction pumps have been proven to provide control and stability to the flow of dielectric refrigerants and solvents for cooling electronic devices, which in turn, provides the aforementioned thermal management requirement.

3. **Li Chang**

The influence of isotropic turbulence on nucleate pool boiling using thin wires

Department: Fire Protection Engineering

Advisor: Ali Rangwala

Degree Level: Ph.D.

Keywords: Nucleate pool boiling, Liquid subcooling, Bubble observation, Critical heat flux, Isotropic turbulence

Description: Boiling is a very efficient way to transfer heat from hot objects to surrounding liquid. The present study explores the effects of turbulence environment on boiling behaviors, where the turbulent velocities are controlled within the range of that from natural water resources. The results help us to understand and improve oil removal during in-situ burning process.

4. **Yinduo Chen**

Identification and Quantification of Inorganic Nanoparticles in Wastewater

Department: Environmental Engineering

Advisor: John Bergendahl

Degree Level: Ph.D.

Keywords: Bayesian computation, Gibbs sampler, Monte Carlo Integration, Multinomial Dirichlet Model, Unimodal order restrictions

Description: Engineered nanoparticles have become increasingly more common in consumer products and industrial processes. Due to the environmental impacts of engineered nanoparticles, it is important to understand the occurrence, fate and transport of inorganic nanoparticles in wastewater treatment plants (WWTPs). This research aims to further develop and improve techniques to identify, quantify, and characterize inorganic nanoparticles in wastewater; and investigate the nature of inorganic nanoparticles in a local WWTP in both influent and effluent streams.

5. **Amanda Dings**

A Psychological Approach for the Path Planning of Human Evacuations in Contaminated Indoor

Department: Aerospace Engineering

Advisor: Michael Demetriou

Degree Level: Ph.D.

Keywords: Level-set, path planning, indoor evacuation, spatially varying fields, psychological effects

Description: This work considers the effects of psychological freezing (due to panic or lack of information) on the evacuation success of a person fleeing an environment contaminated with carbon monoxide (CO). It is shown that the time delay due to psychological freezing has a higher impact on the evacuee's chances of survival than the sheer concentration of CO alone. Future work will consider more complex psychological factors such as potential interactions between evacuees.

6. **Kaoutar Diouri**

Development of an Accurate Method of Structural Design of Overlaid Milled Pavements through Advanced Finite Element Modeling and Field Testing

Department: Civil Engineering

Advisor: Rajib B. Mallick

Degree Level: Ph.D.

Keywords: Milling, Asphalt pavement, Finite Element, Viscoelastic behavior, Von Mises stress

Description: Milling of roadway layers has become almost a routine activity in asphalt pavement rehabilitation all over the world. Effective milling is the key to constructing sustainable pavements. The main objective of this research study is to close the knowledge gap regarding milling-induced stresses and their adverse effects by developing alternative designs and guidelines. The approach consists of developing an explicit Finite Element milling model, and validate the modeling results through laboratory experiments and field-testing.

7. **Nicholas DiReda**

Understanding the mechanism of the Deflagration-to-Detonation Transition (DDT) phenomenon

Department: Aerospace Engineering

Advisor: Jagannath Jayachandran

Degree Level: Master's

Keywords: Combustion, Supersonic, Detonation, Propulsion, Chemistry

Description: Supersonic combustion conditions offer the potential to develop higher efficiency propulsion devices. Experimental studies were performed to elucidate the mechanism controlling the transition of a flame from subsonic to supersonic speeds. Results also provide important safety information for fuel storage and transportation.

8. **Jihan El Ouaragli**

Coupled Sorbent & Thermo-Responsive Polymer Battery For Thermal Energy Storage

Department: Civil Engineering

Advisor: Steven Van Dessel

Degree Level: Ph.D.

Keywords: Thermal energy storage, Sorbent, Polymer, abs/desorption, temperature controlled

Description: An innovative, smart and compact thermal battery for TES, composed of a sorbent and a thermo-responsive polymer engineered in such a way that the sorbent stores thermal energy based on adsorption-desorption principles. The stored heat is then released when the system encounters a thermal stimulus from its environment in a smart, time controlled, and self-contained way.

9. **Jie Fang**

Route planning for multi-vehicle system in unknown environments.

Department: Mechanical Engineering

Advisor: Raghvendra Cowlagi

Degree Level: Ph.D.

Keywords: Route planning, Task assignment, Linear temporal logic, Iterative planning and sensing, Environment exploration

Description: Describe a iterative planning and sensing algorithm for multi-vehicle system. On one side, we aims to computing the optimal routes for the group of vehicles while satisfying the given global mission. On the other hands, we minimize the amount of sensing resources to explore the unknown environment.

10. **Milad Farzad**

Transport Characteristics of the Flow Generated by a Slot Jet Reattachment Nozzle in the Presence of a Moving Plate

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Ph.D.

Keywords: Drying, Heat transfer, Slot jet, Slot jet reattachment, Moving plate

Description: Slot jet reattachment (SJR) nozzle is developed in an attempt to enhance heat and mass transfer characteristics while effectively controlling the impingement surface force exerted by the jet flow. In the SJR nozzle, the jet is directed outward from the nozzle exit and it then reattaches on an adjacent surface in its vicinity. The turbulent mixing occurs at the boundaries of the free stream induces secondary flow by mass entrainment and causes the flow to reattach the surface in the form of an oval reattachment at close nozzle to surface spacing. Therefore, SJR nozzle could be an improved replacement of slot jet (SJ) nozzle in drying of moist materials such as food products, textiles, and pulp and papers. All the previous studies had considered a stationary reattachment surface. This work, for the first time, investigates the impact of reattachment surface movement on heat transfer characteristics of SJR nozzle. In this poster, the flow fields due to slot jet (SJ) and slot jet reattachment (SJR) nozzles over a moving plate at a moderately high Reynolds number have been computed using large eddy simulation (LES) technique. Specifically, this numerical study is conducted by varying the surface-to-jet velocity ratio (V*=V/V_e) from 0 to 1 and comparing them to those of traditional SJ nozzle, where V is the speed of reattachment surface and V_e is the nozzle exit velocity. In this study, nozzle exit temperature was fixed at 400 K and ambient temperature was assumed as 300 K. The Reynolds number (Re) was defined based on the average nozzle exit velocity and hydraulic diameter of SJR nozzle. Numerical results indicate that reattachment surface movement has a negligible effect on the SJR nozzle heat transfer characteristics compared to that of SJ nozzle.

11. **Binod Giri**

Photodetectors Made of Vertical SnS2 Nanoflakes Decorated with PbS Colloidal Quantum Dots

Department: Mechanical Engineering

Advisor: Pratap Rao

Degree Level: Ph.D.

Keywords: Photodetector, Lead Sulfide, Tin disulfide, Scalable, Photolithography

Description: In this project, we have built efficient photodetectors from vertical SnS2 nanoflakes and colloidal PbS QDs using scalable production methods. The SnS2/PbS QD device is fabricated on SiO2/Si substrates with gold contacts patterned using standard photolithography. These devices exhibit excellent responsivity, on-off ratios and transient response needed for an efficient photodetector.

12. **Anass Harmal**

Bio-inspired toughening mechanisms for ecological cementitious materials

Department: Civil Engineering

Advisor: Harold Walker

Degree Level: Ph.D.

Keywords: Geopolymer cement, Biological structural materials, Bio-Inspired mechanisms, Toughening mechanisms, concrete 3D printing

Description: Ecological cementitious materials, Geopolymer cements, emerge as a great alternative to Portland cement which is responsible for about 7% of the CO2 emissions worldwide.

Geopolymer cements, however, are very brittle materials due to their ceramic-like behavior, which creates the need for Geopolymer composites that enable the material to be tough enough for building application. We are looking at the toughening mechanisms in nature as a reference for engineering Tough bio-inspired Geopolymer composites.

13. **Oussama Khouchani**

Bio inspired geopolymer composites

Department: Civil & Environmental Engineering

Advisor: Tahar El-Korchi

Degree Level: Ph.D.

Keywords: geopolymers, Fibers, Bio inspired, Nanoscale

Description: The poster will be about the geopolymers as a sustainable contruction material that will subsitute cement by designing a bio-inspired fibrous composite with nanoparticles.

14. **Mucheng Li**

Lossy Mode Resonance Optical Fiber Sensors for Relative Humidity and Moisture Content Measurement

Department: Mechanical Engineering

Advisor: Yuxiang Liu

Degree Level: Ph.D.

Keywords: Embedding, One shot learning, Compositional representation, Deep learning, Computer vision

Description: There is an urgent need for in-situ relative humidity and moisture content monitoring of food samples during the drying process. We have developed a hair-size fiber optical sensor based on lossy mode resonances for measurement of both relative humidity in air and moisture content in food, and its wide measurement range (can reach less than 5%) and immunity to electromagnetic waves are not achieved by commercially available electric sensors. This fiber optical sensor enables real-time monitoring of moisture content inside food during the drying process and hence improves food quality and safety.

15. **Maryam Masroor Shalmani**

Controlling Crystal Growth of Non-Toxic Bismuth iodide (BiI3) Semiconducting Material for Efficient Photovoltaics

Department: Mechanical Engineering

Advisor: Pratap Rao

Degree Level: Ph.D.

Keywords: Semiconducting materials, photovoltaics, Non-toxic materials, Physical vapor deposition, Cystal growth

Description: We use a physical vapor deposition method for growing crystals of a semiconducting material which has the potential to be used in efficient Photovoltaics.

16. **Ajit Mohekar**

High Power Electromagnetic Heat Exchangers With Gas Coolants: Analytical And Numerical Modeling

Department: Mechanical Engineering

Advisor: Prof. Burt Tilley

Degree Level: Ph.D.

Keywords: Compressible Gases, Electromagnetic Heating, Multiphysics Modeling, Rayleigh Benard Convection, Thermal Runaway

Description: Electromagnetic (EM) heat exchangers (HX) convert EM energy into useful mechanical work. Some examples of EM HX include microwave thermal thrusters that utilize EM energy to generate thrust, wireless power beaming applications where an EM HX would act as the receiver of the incoming EM energy, etc.. Our research centers on modeling EM HX and investigating the role of gas coolants in conversion EM energy into heat or work of thermal expansion.

17. **Arvand Navabi**

Oxide-layer Effects on Interfacial Fracture and Adhesion in Cold Sprayed Metals

Department: Civil Engineering

Advisor: Nima, Winston Rahbar, Soboyejo

Degree Level: Ph.D.

Keywords: cold spray, fracture, additive manufacturing, interface

Description: Adhesion and cohesion in constituents of the layered cold spray material, drive crack initiation and propagation. This study intends to use multiscale computational and experimental methods to better understand fracture toughness and adhesion mechanisms in cold sprayed aluminum 6061, CP Titanium and Ti6Al4V, Tantalum and Molybdenum.

18. **Zahra Noori**

Fundamental Understanding of Removal of Water Trapped Inside a Single Celluolse Fiber

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Ph.D.

Keywords: drying of paper, water removal, energy efficiency, cellulose fiber, bound water

Description: Drying of paper is a very energy inefficient process. A significant portion of energy in paper drying is devoted to bound water removal, which is mainly defined as the water inside the cellulose fibers. In this study, fundamentals of water removal from inside a single cellulose fiber are studied.

19. **Nick Pratt**

Humidity-Resistant Fabrication of Lead Perovskite Solar Cells

Department: Mechanical Engineering

Advisor: Pratap Rao

Degree Level: Ph.D.

Keywords: Perovskite, MetalOxide, Photovolatic, Renewable

Description: Lead perovskite solar cells degrade in the presence of humid air. Here we explored stabilizing the cells by modifying the fabrication method, and by changing the layers of the cell.

20. **Jessica Rosewitz**

Enzyme modification of cementitious materials

Department: Civil Engineering

Advisor: Nima Rahbar

Degree Level: Ph.D.

Keywords: Concrete, Self-healing, Enzyme, Calcium carbonate, Carbonic anhydrase

Description: An enzyme, Carbonic anhydrase, is used in two ways to strengthen existing and new concrete structures. For existing damaged concrete, the enzyme catalyzes formation of calcium carbonate which repair cracks and seal surfaces. For new structures, the enzyme is mixed into wet concrete before casting, and produces a final product with higher tensile strength and reduced permeability.

21. **Daniel Ruiz-Cadalso**

Design and rapid prototyping of fiber-optic based micro-force sensors by two-photon polymerization

Department: Mechanical Engineering

Advisor: Cosme Furlong

Degree Level: Master's

Keywords: micro-sensors, fiber-optics, rapid prototyping, two-photonpolymerization, hearing mechanics

Description: We are developing fiber-optic based micro-sensors for measurement of dynamically induced micro- to nano-Newton forces. These micro-sensors have low-stiffness, which is required for characterization of biomedical samples and soft materials, and are rapid prototyped by two-photon polymerization methods. We report their performance as applied to several applications, including measurements of acoustically induced forces on the Tympanic Membrane surface to better understand hearing and middle-ear mechanics.

22. **Yao Shen**

All-fiber modular optical tweezers for physical and biological study in liquid and air environments

Department: Mechanical Engineering

Advisor: Yuxiang Liu

Degree Level: Ph.D.

Keywords: Optical force, Optical tweezers, Micro/Nano manipulation, Photophoretic trapping, Biomechanical measurement

Description: Optical tweezers (OTs) are versatile tools to manipulate and detect micro/nanoscale objects by applying optical force without any physical contact. In this work, we demonstrate an all-fiber modular optical tweezers (AFMOTs) that provide a portable, robust, and flexible platform for in-situ applications in physics and biomechanics. AFMOTs enables single cancer cell measurement and airborne carbon particles trapping and hence finds various applications in both liquid and air environments.

23. **Xin Tian**

Domain Decomposition for a Hybrid State Estimation of a Plume Field with a Moving Sensor

Department: Aerospace Engineering

Advisor: Nikolaos Gatsonis

Degree Level: Ph.D.

Keywords: Hybrid Estimator, Non-overlapping Domain Decomposition, Real-time Estimation, Open Mp ParallelImplementation

Description: The research presents the development of a real-time estimation method of the plume concentration from a stationary or moving gaseous source using a sensing aerial vehicle. The research is important for both national security and environmental applications. A hybrid estimator is developed and is implemented numerically in OpenMP using a heterogeneous non-overlapping domain decomposition explicit method. The estimator onboard a sensing aerial vehicle is used in simulations of a moving aerial intruder in city-scale domain with realistic atmospheric conditions.

24. **Amanda Toledo Barrios**

Adhesion Measurements in Graphene-Elastomer Composite Systems

Department: Aerospace Engineering

Advisor: Nikhil Karanjgaokar

Degree Level: Master's

Keywords: Interface, Adhesion, Graphene, Graphene Oxide, PDMS

Description: Flexible electronics are typically granular composite materials that are composed of soft elastomeric matrices bonded to hard conductive filler elements. They serve as replacements to conventional rigid electronic systems and find use in many high-performance applications such as foldable solar cells, biomechatronic implants, and soft-robotic actuators which undergo various stress cycles inherent to their application, resulting in failure commonly found at the binder-particle interface. Thus, this work focuses on understanding the interfacial behavior between the viscoelastic binder (i.e., PDMS) and filler particles (i.e., Graphene and Graphene Oxide) to improve the composite material design.

25. **Chao Wang**

Effect of changing air quality and air exchange rate in vehicle cabin on driving performance

Department: Civil Engineering

Advisor: Shichao Liu

Degree Level: Ph.D.

Keywords: Driving performance, Air quality, Air exchange rate, Vehicle cabin, Human cognition

Description: The purpose of this study is to examine the effects on human driving performance of exposure to carbon dioxide, other bioeffluents, and different air exchange rates in the vehicle cabin. The poster will include the design of the driving simulation experiment, the collection of physiological data from subjects, the methods of data analysis and the result of how air quality and air exchange rate affect driving performance.

26. **Shuai Wang**

Sprayed fire resistance materials

Department: Civil Engineering

Advisor: Nima Rahbar

Degree Level: Ph.D.

Keywords: Job Search, Graduate Students, User Experience, Employment, The United States

Description: Prevent steel structures fail in fire

27. **Yutao Wang**

From Waste Steel to Materiel: Additive Manufacturing Enabled Agile Manufacturing

Department: Manufacturing Engineering

Advisor: Jianyu Liang

Degree Level: Ph.D.

Keywords: electromyogram, myoelectric signal processing, EMG standard deviation, probability distritbution, Maximum likelihood estimate

Description: An effective sorting, chemical composition monitoring and composition adjustment process for iron wastes was created. A novel ceramic shell casting process, which takes advantage of the manufacturing capabilities of additive-manufacturing technologies was studied.

28. **Mengqiao Yang**

Enhancement of Drying Rate of Moist Porous Media with Electric Field

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Ph.D.

Keywords: Drying, Electric Field, Moist Porous Media, Dielectrophoresis, Energy Consumption

Description: Drying of moist porous media, such as food, pulp and paper, is an energy-intensive process. Traditional drying technologies have disadvantages including high energy consumption, thermal degradation of the samples as well as high capital cost. In this work, a new drying technology making use of the Dielectrophresis (DEP) is introduced. This new technology has advantages among higher drying rate, lower temperature distribution, minimal energy consumption as well as low capital cost.

29. **Zhaolong Zhang**

Impact of Process Control on Product Quality by Ceramic Robocasting Technique

Department: Manufacturing Engineering

Advisor: Jianyu Liang

Degree Level: Ph.D.

Keywords: Motivation, Degradable methods, Innovation, Equation of state, Oil recovery

Description: Advanced ceramics have been widely used in aerospace, automotive, and other industries. To achieve the geometric and material property complexities that are difficult to obtain in conventional m manufacturing methods, additive manufacturing of ceramic materials has attracted increasing attention in recent years. Robocasting technique is one of the most widely used additive manufacturing method for ceramic based material. It provides an easy to implement process that can accommodate a large selection of different ceramic materials at relatively low cost. However, there are limitations for the Robocasting method to fabricate complex 3D structure. A control/feedback system for Robocasting printers is needed to achieve accuracy control of the amount of material being deposited. It is known that the viscosity of the ceramic slurry significantly influences the latency in operation and the quality of the green body produced by the printer. However, the influence of rheology has not been well studied. In this research, the key parameters for accurate process control of ceramic Robocasting technique are studied to improve the quality of the printed products.

30. **Mengxuan Zhao**

Laboratory Testing Procedure for Chemical Deformation of Metakaolin-based Geopolymers

Department: Civil Engineering

Advisor: Mingjiang Tao

Degree Level: Ph.D.

Keywords: lighting, ar, mobile, graphics, system

Description: Geopolymer, emerged as a promising alternative to ordinary Portland cement, was deep investigated on the mechanical properties, fire resistance, and immobilization of deleterious elements etc. by majority groups. But there is still a huge gap in shrinkage properties of geopolymer. The shrinkage is one of the main reasons attributes the early age cracking and cause huge damage in civil engineering. Especially the chemical shrinkage, which form the initial cracks inside the material and cause the big cracking after propagating.

Business and Social Science

31. **Kathryn Drzewiecki**

Preliminary Exploration of the Role of Math Anxiety on Performance Outcomes in Mathematics Learning

Department: Learning Sciences & Technologies

Advisor: Erin Ottmar

Degree Level: Master's

Keywords: mathematics education, structural equation modeling, exploratory, education, SEM

Description: Mathematics anxiety plays a large role in how well students learn math. This is a preliminary exploration of the potential role of mathematics anxiety on mathematics learning in online problem sets.

32. **Avery Harrison**

The Effect of Physical Spacing in Mathematics Expressions on Student Performance

Department: Learning Sciences & Technologies

Advisor: Erin Ottmar

Degree Level: Ph.D.

Keywords: mathematics, cognition, perception, learning, spatial

Description: This poster will present the findings from a study exploring the effect of physical spacing within mathematical expressions on student performance. A total of 2,458 students in 5th-12th grade were randomly assigned to one of four conditions within an online problem set, where participants saw algebraic equations with terms that were spaced 1) neutrally, with no spaces in the expression, 2) consistently, with spacing which supports the order of precedence through grouping terms, 3) inconsistently, with spacing which does not support the order of precedence, or 4) mixed, a combination of the previous conditions.

33. **Alicia Howell-Munson**

Using fNIRS to categorize reactive and proactive cognitive control in brain data

Department: Bioinformatics & Computational Biology

Advisor: Erin Solovey

Degree Level: Ph.D.

Keywords: fnirs, cognitive neuroscience, mind-wandering, brain data, continuous performance task

Description: Proactive and reactive control are two types of cognitive control seen during learning. By combining data received from a computer-based task and a functional near-infrared spectroscopy machine (fNIRS), we could define these phases in brain data. The brain data will be used in the future to adjust the difficulty of math problems administered on a computer to the student's need.

34. **Hannah Smith**

The Effects of Enacted Linear Board Games on Numerical Knowledge

Department: Learning Sciences & Technologies

Advisor: Ivon Arroyo

Degree Level: Master's

Keywords: board games, preschoolers, early childhood mathematics, numerical magnitude, number sense

Description: This study examines the effects that different versions of linear board games have on preschoolers' number sense abilities. Participants were given number sense measures before and after playing one of four board games including typical table-top games with handheld playing pieces and physically active games which allowed children to use their bodies as playing pieces.

35. **Weizhen Qin**

The Financial Risks of Banks in the U.S., China, and Japan: Do Bad Loan and Deposit Matter?

Department: Marketing & Innovation

Advisor: Huong Higgins

Degree Level: Master's

Keywords: Financial Crisis, Bank, Financial Risk, Bad Loan, Deposit

Description: This study compares the financial risks of banks in the United States, China, and Japan. The examined data sample consists of over 15 years including the time before and after the 2008 financial crisis. The study offers important implication for financial analysis by evidencing different usefulness of bad loan and deposit information in bank risk analysis.

36. **Nelson Achelengwa**

Studying the Engagement of Relax Pilot Users

Department: Information Technology

Advisor: Bengisu Tulu

Degree Level: Master's

Keywords: Relax, Engagement, Engagement Index, Interaction, Loyalty

Description: Performing engagement analyses on the data collected from 22 Relax Pilot users from May 6 to June 16 in view of determining how engaged these users were with the app. We equally investigated any correlations between app features and user engagement. From these, we determined the strengths and weaknesses of the app which will be used in for future upgrades.

37. **Shima Azizi**

Improving Community Paramedicine: Selective, Proactive Treatments of Patients

Department: Business Administration

Advisor: Andrew Trapp

Degree Level: Ph.D.

Keywords: Community paramedicine, Improve societal health, Mixed-integer optimization model, Canton-Potsdam Hospital, Proactive Treatments of Patients

Description: Community paramedicine is a recent healthcare innovation that enables proactive visitation of patients at home, often shortly after Emergency Department and hospital discharge. We propose to reduce both hospital costs and readmissions, and increase patient welfare. We develop an integer program that selects patients and routes healthcare providers to maximize overall patient welfare, while prioritizing shorter tours. We discuss our computational experiments on a variety of test instances inspired by real, deidentified data from a rural hospital system, which solve in reasonable runtimes.

38. **Stephen Frimpong-Manso**

Measuring the Success of Neurodiversity Job Placement Programs in High Tech Industries

Department: Information Technology

Advisor: Eleanor Loiacono

Degree Level: Master's

Keywords: Neurodiversity, recruitment, employment success, disability, tech companies

Description: This research looks at neurodiverse job placement/recruitment programs in the high-tech industry. In particular, it looks at how to measure the success of these programs. To do this, it uses a three-fold approach: (1) success from the employer’s point of view, (2) success from the employee’s point of view and (3)success from the point of view of the “middleman.”

39. **Haadi Mombini**

Chronic Wound Care Decision Support for Non-expert Clinicians using Explainable Machine Learning Algorithm

Department: Business Administration

Advisor: Bengisu Tulu

Degree Level: Ph.D.

Keywords: Machine learning, Explainable, Decision support, Chronic wounds, Non-expert

Description: This poster envisions a smartphone clinical decision support system (CDSS) App that will take as an input a single wound image and predicts a suitable wound care decision that is explained in simple IF-THEN statement rules to a non-expert clinician. The care decisions are: (1) continue with the current treatment, (2) request a non-urgent change in treatment from a wound specialist, or (3) refer the patient to a wound specialist.

40. **Javad Norouzi Nia**

Distinction of Decision-Making Patterns Using Eye-Tracking Data

Department: Business Administration

Advisor: Soussan Djamasbi

Degree Level: Ph.D.

Keywords: Decision Making, Eye Tracking, User Experience, Marketing, Human Computer Interaction

Description: We used eye-tracking to view decision-makers' gaze data and identify discerning eye-activity patterns while making different types of decisions. The ability to distinguish different decision-making processes can help us to identify different types of users better.

41. **Zhengya Wang**

Improve the User Experience of Employment Websites: A Study on Graduate Students' Job Searching Process in United States

Department: Learning Sciences & Technologies

Advisor: Soussan Djamasbi

Degree Level: Master's

Keywords: EMG, Signal processing, Whitening filter, Differential evolution algorithm, Filter design

Description: The user experience design of the employment websites, which bridges the graduate students and the employers, would directly affect the utilization rate of human resources in the recruitment market. This project aims to improve the user experience of the employment websites by conducting field study experiment on graduate students' job searching process and patterns. The current phase of this project would be mainly focusing on the graduate students of WPI.

42. **Shimi Zhou**

Smart Cities for All

Department: Business Administration

Advisor: Eleanor Loiacono

Degree Level: Ph.D.

Keywords: 3D microfluidics; in vitro; Cancer migration; Vimentin, 3D microfluidics, In vitro, Cancer migration, Vimentin

Description: This project is the first step in a longer-term plan of research.

Step 1. A literature review was conducted to understand the current state of smart city research in the IS discipline. Step 2. The Quadruple Helix Theory is applied as a conceptual framework in which to understand how smart cities can be structured to support people with disabilities.

Life Sciences and Bioengineering

43. **Alycia Abbott**

Effect of Lyophilization Drying Time and Temperature on Silk Fibroin Scaffold Structural Properties

Department: Biomedical Engineering

Advisor: Jeannine M. Coburn

Degree Level: Ph.D.

Keywords: biomaterial, characterization, mechanicaltesting, tissueengineering, modeling

Description: Silk fibroin is a protein from silk worm cocoons that can be used as a biomaterial in many tissue engineering applications. When silk fibroin is lyophilized (or freeze-dried) it creates porous scaffolds that look and feel similar to sponges. This work investigates how the modification of freeze-drying parameters affects the structural properties of the resultant porous scaffolds

44. **Habibeh Ashouri Choshali**

The Effects of Mechanical Stress on the Collective Cell Behavior on Micropatterned Substrates

Department: Civil Engineering

Advisor: Nima Rahbar

Degree Level: Ph.D.

Keywords: Cell mechanics, collective cell behavior, Traction Force Microscopy

Description: Acto-myosin machinery of the cell creates contractile forces which result in stress and strain fields within the cell aggregate. Recent evidence proposes that the mechanical stresses regulate collective cell behavior including cell migration, cell differentiation, apoptosis and cell proliferation [1-3]. However, it still remains unclear what is the exact mechanical signal that leads to local tissue pattern formation. This work explores the effect of substrate stiffness and cell monolayer inhomogeneity on the collective cell behavior both numerically by finite element modeling (FEM) and experimentally by measuring the traction forces.

45. **Jordan Jones**

Decellularized Spinach: The First Step to Lab-grown Steak

Department: Biomedical Engineering

Advisor: Glenn Gaudette

Degree Level: Ph.D.

Keywords: cultured meat, cellularagriculture, scaffold, decellularized spinach

Description: Land required to raise livestock has resulted in rampant deforestation around the world, including irreparable damage to the Amazon rainforest. It is imperative to produce meat with characteristics that better replicate the structure of traditionally produced meat that minimizes land use without slaughtering livestock. We propose that a lab-grown steak can be created by layering using decellularized spinach leaves as the scaffold.

46. **Megan Mancuso**

Bone Strain, Bone Gain? Measuring Load-Driven Bone Adaptation in the Forearm of Healthy Women

Department: Biomedical Engineering

Advisor: Karen Troy

Degree Level: Ph.D.

Keywords: Biomechanics, Bone, Finite Element Analysis, Image Analysis, Adaptation

Description: While exercise is generally considered beneficial for bone health, the relationship between externally applied force, tissue-level bone loading, and changes in bone structure is not well-understood for humans. In this study, healthy premenopausal women applied cyclic loading to their non-dominant forearm three days per week over twelve months. To better understand how tissue-level deformation drives adaptation, we related longitudinal changes in bone structure to bone strain estimated using subject-specific computational models considering bone geometry and applied force.

47. **Katelyn Mistretta**

Sustained Release of Berzosertib as a Radiosensitizer for the Treatment of Neuroendocrine Tumors

Department: Biomedical Engineering

Advisor: Jeannine Coburn

Degree Level: Ph.D.

Keywords: Cancer, Hydrogel, Controlled Release, Chondroitin Sulfate, Chemotherapy

Description: Systemic administration of chemotherapeutics for the treatment of neuroendocrine tumors requires high dosing to be effective and is associated with severe systemic toxicity. Our lab has developed a methacrylated chondroitin sulfate (CSMA) hydrogel which can be reversibly loaded with certain positively charged compounds, such as chemotherapeutics, for sustained release in vivo. Berzosertib is a potently toxic chemotherapeutic agent which prevents DNA damage checkpoint activation in cancerous cells, preventing them from repairing DNA damage and triggering apoptosis. ATR inhibitors such as Berzosertib can also be used in combination with radiation therapy to further increase DNA damage and cellular apoptosis. Preliminary in vitro trials using Berzosrtib have shown ideal loading and long-term linear release from CSMA hydrogels.

48. **Kyle Murdock**

Risk Factors for Stress Fractures in Runners

Department: Biomedical Engineering

Advisor: Karen Troy

Degree Level: Ph.D.

Keywords: Metatarsal Stress Fracture Injury Biomechanics

Description: The goal of this study was to identify risk factors associated with metatarsal stress fractures in runners. The bone structure of runners with bone stress injury was compared to healthy runners.

49. **Gian Marco Paci**

A Pulsatile Bioreactor for Tissue Engineered Blood Vessels

Department: Biomedical Engineering

Advisor: Marsha Rolle

Degree Level: Master's

Keywords: Bioreactor Pulsatile Tissue Engineering

Description: We developed a device that permits to culture biological vascular tissue with tunable and physiological mechanical stimulation. The current work focuses on testing the device with synthetic blood vessels and on finding a proper protocol to culture them.

50. **Mohammed Masrur Rahman**

Cultured Hairy Roots in Tissue Engineering Applications

Department: Biomedical Engineering

Advisor: Jeannine Coburn

Degree Level: Master's

Keywords: Plant, Biomaterial, Cells, Protein, Hairy roots

Description: Plant derived matrices provide alternative biomaterials for tissue engineering. Hairy roots from tobacco plant cultures can serve as a novel platform for cell seeding purposes and provide vascular networks in conjunction with other biomaterials.

51. **Pengbo Wang**

Fiber-based Optical Tweezers Triggered Morphological Changes of Human Breast Epithelial Cancer Cells

Department: Physics

Advisor: Qi Wen

Degree Level: Ph.D.

Keywords: A new materials to resist steel structures failure

Description: According to our experiment results, optical tweezers can trigger resumable morphological changes of human breast epithelial cancer cells. This kind of effect triggered by optical tweezers can be decoupled to three factors: temperature, force and light. Now we are trying to study the effects of human breast epithelial cancer cells with these three factors individually.

52. **Melissa Wojnowski**

Bioactive functionalization of silk fibers for spatial and temporal control of cell development in hydrogel scaffolds

Department: Biomedical Engineering

Advisor: Jeannine Coburn

Degree Level: Master's

Keywords: tissue engineering, biomaterial, functionalization, silk, hydrogel

Description: Tissue engineering depends on the dynamic relationship between a triad of factors: the cells, the scaffold on which the cells develop, and the regulatory signals that guide cellular development. Creation of a biomaterial that establishes spatial and temporal control of this interplay is critical for effectively mimicking the physiological microenvironment of the tissue of interest, but the specificity of the scaffold and signals necessary to achieve successful cellular development means that it is difficult to translate one such functional biomaterial to use for several different tissue types. By maximizing physical and biomolecular tunability of silk microfibers suspended in hydrogels, we have developed a method for producing a highly tailorable biomaterial that increases physiological versatility of tissue engineering scaffolds without sacrificing physiological specificity.

53. **Samantha Bryce**

A Gut Feeling: The role of food sensing in fungal infection

Department: Biology & Biotechnology

Advisor: Reeta Rao

Degree Level: Master's

Keywords: Fungal infection, Gut-brainaxis, Microbiome, Microbialinfection, Sensoryneurons

Description: If you have ever had “butterflies in your stomach” you know that these sensations emanating from your gut suggest that your brain and gut are connected. Recent studies suggest that the health of one’s gut can affect their mental brain. This communication is called the gut-brain axis. We are using the roundworm *C. elegans* to map the sensory neurons that allows the worm to detect and respond appropriately to foods that make it sick and ultimately survive *C. albicans* fungal infections.

54. **Minh Tri Ho Thanh**

Reduced vimentin level in fibroblasts regulates cell traction force but not mechanosensing

Department: Physics

Advisor: Qi Wen

Degree Level: Ph.D.

Keywords: Mechanosensing, Traction Force Microscopy, Cytoskeleton, Mechanotransduction, Fibroblasts

Description: This poster presents the study of effect of reducing vimentin expression (which is usually - in cancer cells) on fibroblasts' ability to mechanically sense their extracellular environment. We observed that both control and vimentin knockdown fibroblasts increase cell spreading area, aspect ratio, total traction force, maximum traction stress when gel stiffness is increased. Thus, we demonstrated that reduction in vimentin expression does not affects fibroblasts’ mechanosensitivity. However, lower vimentin expression reduced total traction force suggesting that force transmission mechanism is impaired.

55. **Dayna Mercadante**

Modeling Cancer Cell Division

Department: Bioinformatics & Computational Biology

Advisor: Amity Manning

Degree Level: Ph.D.

Keywords: Mitosis, Cancer, Modeling, Dynamics, Forces

Description: Cancer cells can have specific characteristics that prevent them from dividing properly into two healthy daughter cells. Modeling how these characteristics influence cell division in cancer cells can provide insight into therapeutic targets for cancer.

56. **Oleksandr Narykov**

Determining rewiring in protein-protein interaction networks induced by alternative splicing

Department: Computer Science

Advisor: Dmitry Korkin

Degree Level: Ph.D.

Keywords: Alternative splicing, Machine learning, Protein-protein interactions, Network analysis, Type 2 diabetes

Description: We present a machine learning model trained to capture differences alternatively spliced isoforms introduce to protein interaction pairs and identify disrupted interactions. Analysis of changes in PPI network is performed for type 2 diabetes mouse case study.

57. **Jocelyn Petitto**

Nucleo-Mitochondrial Gene Regulation

Department: Bioinformatics & Computational Biology

Advisor: David Grunwald

Degree Level: Ph.D.

Keywords: mitochondria, genomics, fluorescent microscopy, lncRNA, retrograde response

Description: As the mitochondria began its transition from bacteria to eukaryotic cell organelle, some number of mitochondrial genes were integrated into the nuclear genome while a few remained in the mitochondria. There is evidence of communication between these two genomes. We are investigating the messages sent by the mitochondria to the nucleus in the form of lncRNA using a combination of RNA sequencing and fluorescent microscopy.

58. **Huaming Sun**

Understanding the determinants of mRNA stability in Mycobacterium tuberculosis

Department: Bioinformatics & Computational Biology

Advisor: Scarlet Shell

Degree Level: Ph.D.

Keywords: Mycobacterium tuberculosis, mRNA, Degradation, Determinants, Pattern

Description: Mycobacterium tuberculosis is able to infect, survive and proliferate within the harsh microenvironment created by human host. A refined understanding of mRNA degradation mechanism in Mycobacterium tuberculosis is key to shed light on how it adapts to the harsh environments.

59. **Elizabeth van Zyl**

Characterization of Transparent Bacterial-Derived Cellulose Produced with Alternative Carbon Sources

Department: Biomedical Engineering

Advisor: Jeannine Coburn

Degree Level: Ph.D.

Keywords: Biomaterials, Transparent Films, Cellulose, Bacterial Culture, Tissue Engineering

Description: Bacterial-derived cellulose (BC) has become a prominent material for biomedical research applications due to its ease of fabrication, biocompatibility, high yield strength, and water retention properties. Optical clarity, however, has not been consistently observed in pure BC, limiting its use in applications such as corneal tissue engineering and optical biosensing. We outline the production and characterization of consistent optically clear BC pellicles produced with alternative carbon sources from Gluconacetobacter bacteria culture.

60. **Diego Vargas Blanco**

Regulation of mRNA stability in mycobacteria as an adaptive response to stress conditions

Department: Biology & Biotechnology

Advisor: Scarlet Shell

Degree Level: Ph.D.

Keywords: mRNA stability, mycobacterium tuberculosis, metabolism, RNAseq, stress conditions

Description: Mycobacterium tuberculosis success as a human pathogen is in part due its ability to survive stress conditions by entering non-growing states, a key point for development of antibiotic resistance. While numerous bacteria have shown to have reduced mRNA turnover under stress, the mechanisms underlying this phenomenon remain unknown. Our research in mycobacteria is aimed at uncovering these mechanisms, which could be used as target by new anti-tuberculosis drugs.

61. **Ying Zhou**

The role of RNase E in mRNA metabolism in Mycobacterium smegmatis

Department: Biology & Biotechnology

Advisor: Scarlet Shell

Degree Level: Ph.D.

Keywords: Smart City, Disability, Innovation System, Accessibility, IT utilization

Description: Tuberculosis (TB) is caused by Mycobacterium tuberculosis (Mtb). A major challenge in TB treatment is the high tolerance of Mtb to various types of stress, including antibiotics and hypoxia.We sought to understand mRNA degradation machinery in mycobacteria by investigating the role of RNase E, an enzyme involved in both mRNA degradation and selective mRNA stabilization in E. coli.

Robotics Enigneering, Cyberphysical Systems, Electrical and Computer Engineering

62. **Ian Costanzo**

A Prototype Towards a Transcutaneous Oxygen Sensing Wearable

Department: Electrical & Computer Engineering

Advisor: Ulkuhan Guler

Degree Level: Ph.D.

Keywords: blood gas monitoring, biomedical wearable sensor, transcutaneous oxygen, flourescent oxygen sensor, respiration monitoring

Description: Continuous and accurate remote monitoring of patients can help care providers improve the quality of care and would allow patients to have greater freedom outside the hospital. This work presents a prototype of an oxygen sensing platform that can be transformed into a wearable for monitoring partial pressure of transcutaneous oxygen (PtcO2). Unlike the widespread peripheral saturation of oxygen (SpO2) measurement, which is a surrogate measure of oxygen bonded to hemoglobin in red blood cells, PtcO2 measures the oxygen diffused from the arteries through the capillaries. PtcO2 has a linear relationship to oxygen partial pressure in the arteries (PaO2).

63. **Jakub Tomasz Kaminski**

Robot-Assisted Ultrasound Imaging for Repetitive Follow-up Assessment of Thyroid Disease

Department: Robotics Engineering

Advisor: Haichong Zhang

Degree Level: Master's

Keywords: medical robotics, ultrasound imaging, motion planning, image processing, thyroid disease

Description: We propose a co-robotic ultrasound imaging system which offers repeatable, safe examinations and highly informative 3D ultrasound scans for better diagnosis. The developed robotic system executes the scanning procedure in a repeatable patient-specific manner during follow-up examinations through force sensing and computer vision techniques. It aims at improving future healthcare through affordable medical imaging procedures to proactively tackle thyroid disease - a large-scale problem in the US society.

64. **Arsalan Akhter**

Team Orienteering for Fuel Constrained Robots

Department: Robotics Engineering

Advisor: Carlo Pinciroli

Degree Level: Ph.D.

Keywords: Integer Programming, Multi-robot systems, Task Allocation, Orienteering problem, Fuel Constraints

Description: In multi-robot systems, sometimes we need mobile robots that could visit certain task locations. We can save fuel for these robots if the order of task visits could be optimized. We discuss Integer programming based techniques to solve the above problem.

65. **Yasmina Benkhoui**

crack detection using deep learning

Department: Electrical & Computer Engineering

Advisor: Tahar El Korchi

Degree Level: Ph.D.

Keywords: crack detection, deep learning, dilated convnets

Description: crack detection in concrete using deep learning

66. **Joshua Amrith Raj Caleb Chanthi Raj**

Autonomous Vision-based In-hand Manipulation by Leveraging Variable Friction Fingers

Department: Robotics Engineering

Advisor: Berk Calli

Degree Level: Master's

Keywords: within-hand manipulation, dexterous manipulation, vision-based control, motion planning, variable friction

Description: The ability to conduct in-hand manipulation provides significant dexterity and flexibility advantages, which would greatly benefit robots operating in unstructured and dynamic environments. Yet, robotic within-hand manipulation is challenging to implement, even for highly articulated, sensorized and expensive robotic hands, mainly due to the lack of accurate hand-object and contact models. In this work, we propose methods for autonomous in-hand manipulation via vision-based control and planning using an inexpensive robotic hand with variable friction surfaces.

67. **Shou-Shan Chiang**

Geometric Search-Based Inverse Kinematics of Continuum Maniplator

Department: Robotics Engineering

Advisor: Cagdas Onal

Degree Level: Ph.D.

Keywords: continuum maniplator, inverse kinematics, lattice search based planning

Description: Continuum robots have many advantages such as dexterity, intrinsic compliance and design compactness, however, the analytic solutions of the inverse kinematics (IK) may not exist because of their hyper-redundant kinematics. The generalized inverse Jacobian method, which is often used for the IK problem, is computational demanding and sometimes fails. Our heuristic approach is using lattice search based algorithm inspired by the motion planning algorithm from self driving car. The algorithm is straightforward and efficient.

68. **Alex Chiluisa**

A Geometric Framework to Aid in the Design of Patient-Specific Notched-tube Continuum Joints.

Department: Robotics Engineering

Advisor: Loris Fichera

Degree Level: Ph.D.

Keywords: Asymmetric notched-tube, Medical instruments, Continuum joints, Geometric design framework, Minimally-invasive surgery

Description: Minimally-invasive surgery is constantly being redefined by surgeons and engineers as they work to progressively reduce the size of surgical instrumentation. Instrument miniaturization normally comes at the expense of dexterity and range of motion. We propose a simple flexure-based articulation joint that overcomes the range-of-motion limitations of existing bending mechanisms, and that we can pre-program to bend in any arbitrary curvilinear shape.

69. **Snehal Dikhale**

Recyclable Waste Sorting using a Robotic Arm with an Adaptive Gripper

Department: Robotics Engineering

Advisor: Calli Berk

Degree Level: Master's

Keywords: Recycling waste, Grasping, Manipulation, Computer Vision, Deep Learning

Description: Controlling and manipulating a Robotic Arm, to segregating Recyclable waste in sorting facility, using a deep learning algorithm. An Adaptive Gripper would be attached to the Robotic Arm for grasping the recyclable items. I will be comparing the performance of the adaptive gripper with suction grippers currently used in robotic waste sorting units.

70. **Katie Gandomi**

Finite Element Modeling for Ultrasonic Conformal Thermal Ablation with MRTI Validation

Department: Robotics Engineering

Advisor: Gregory Fischer

Degree Level: Ph.D.

Keywords: MRI Compatible Robotics, Ultrasonic Thermal Ablation, Finite Element Modeling, Neurosurgery, MRTI

Description: The primary aim of cancer treatment is to remove malignant cells while conserving parenchymal tissue. Achieving appropriate margins can be difficult for deep brain tumors that are unsuited for conventional surgical interventions. One minimally invasive treatment option under research for these clinical cases is needle based therapeutic ultrasound (NBTU). The NBTU probe consists of a cylindrical piezoelectric transducer which, when excited, produces high frequency acoustic waves that are absorbed by the tumor leading to localized heating and death of cancer cells. In order to effectively ablate the entire area of the tumor and minimize damage to healthy cells, model-based control of thermal dose may be necessary. In this work, we present finite element modeling for an NBTU probe and provide validations using magnetic resonance thermal imaging (MRTI).

71. **Shang Gao**

Multi Fiber-Based Photoacoustic Microscopy System Using Single Element Transducer and Delta Configuration Actuator

Department: Robotics Engineering

Advisor: Haichong (Kai) Zhang

Degree Level: Master's

Keywords: Photoacoustic Imaging, Medical Imaging, Medical Robotics

Description: Photoacoustic (PA) imaging is a biomedical imaging modality based on the use of laser-generated ultrasound that has emerged over the last decade. The project objective aims to build a photoacoustic imaging platform with a single element transducer and multi optical fibers actuated with delta configuration robotics. The developed platform provides the targeted resolution of 100-300 micro with reduced cost to democratize preclinical research using ex-vivo tissue samples and small animals.

72. **Akshay Iyer**

Illumination induced errors in semantic segmentation of wound images : Analysis and mitigation using intrinsic image decomposition

Department: Robotics Engineering

Advisor: Emmanuel Agu

Degree Level: Master's

Keywords: Computer vision, Deep learning, Illumination, Semantic Segmentation, Wounds

Description: Adverse illumination has been shown to affect wound area measurements. This research involves a comprehensive investigation of how changing illumination and camera parameters affects semantic segmentation of wound images. Based on the analysis results, deep learning based techniques are employed to make the segmentation robust to adverse lighting. This work is done as a part of the SmartWands project, an app for detecting, analyzing and managing chronic wounds.

73. **Rahul Krishnan**

Model based Systems Engineering Approach to Safety Analysis

Department: Systems Engineering

Advisor: Shamsnaz Virani Bhada

Degree Level: Ph.D.

Keywords: odel Based Systems Engineering, System Safety, FMEA, FTA, Hazard analysis

Description: The focus of this research is to use models of the system architecture to automatically generate safety artifacts like FMEA tables and fault trees. This allows engineers to evaluate system design from a safety perspective during early stages of system design and development. The model based approach to safety analysis also increases traceability and consistency between system and safety models.

74. **Jennifer Legaspi**

Introducing digital doppelgängers for health care policy analysis

Department: Systems Engineering

Advisor: Shamsnaz Bhada

Degree Level: Ph.D.

Keywords: Modeling, Systems Engineering, Policy, Simulation, Resource Allocation

Description: The complexity of many systems such as health care, communications, or education in the U.S. serves as a barrier to the implementation of policy to improve those systems. Model-based systems engineering (MSBE) can be used to create detailed models of a system to assist in the policy-making process.

75. **Jianan Li**

EMG wireless system with time sync method

Department: Electrical & Computer Engineering

Advisor: Adward Clancy

Degree Level: Ph.D.

Keywords: timesync, wireless, signal processing

Description: Using BLE method to acquire wireless EMG data and apply time sync method to ensure synchronize multiple channels.

76. **Tsung-Chi Lin**

Shared Autonomous Interface for Reducing Physical Effort in Robot Teleoperation via Human Motion Mapping

Department: Robotics Engineering

Advisor: Zhi Li

Degree Level: Ph.D.

Keywords: Teleoperation, Telerobotics, Human Factors, Human in the Loop, Medical Robots

Description: In this paper, we investigate how teleoperation assistance in terms of shared autonomy can be used to reduce the physical workload in robot teleoperation via motion mapping.

77. **Yecheng Lyu**

Learning to Segment 3D Point Clouds in 2D Image Space

Department: Electrical & Computer Engineering

Advisor: Ziming Zhang

Degree Level: Ph.D.

Keywords: PointCloud, Segmentation, CNN, Graph, DeepLearning

Description: In contrast to the literature where local patterns in 3Dpoint clouds are captured by either clustering or customizedconvolutional operators, in this paper we study the problemof how to effectively project such point clouds into a 2Dimage space so that conventional image-based convolutionalneural networks (CNNs) such as U-Net can be applied di-rectly for segmentation. To this end, we are motivated bythe graph drawing algorithms, and thus propose an integerprogramming formulation to learn the topology-preservinggraph-to-grid mapping for each individual point cloud. Toaccelerate the computation in practice, we further propose anovel hierarchical graph drawing algorithm. With the helpof the Delaunay triangulation for graph construction frompoint clouds and a multi-scale U-Net for segmentation, wemanage to demonstrate the state-of-the-art performance onShapeNet and PartNet, respectively, with significant improve-ment over the literature.

78. **Sean McGovern**

Learning to estimate the centers of mass of arbitrary objects

Department: Robotics Engineering

Advisor: Jing Xiao

Degree Level: Ph.D.

Keywords: reinforcement learning, manipulation, centerofmass, unknownobjects

Description: This paper introduces a reinforcement learning algorithm with robot manipulation to learn an arbitrary object's center of mass whose physical material composition is unknown. Robot learning is through manipulation of the object in a sequence of actions. The effectiveness of the algorithm is demonstrated in simulation to locate the centers of mass of rocks with complex shapes, with even or uneven mass distributions, and confirmed by vertically stacking the rocks along their learned centers of mass both in simulation and in real experiments.

79. **Jayam Umesh Patel**

Improving Human Performance Using Mixed Granularity of Control in Multi-Human Multi-Robot Interaction

Department: Robotics Engineering

Advisor: Carlo Pinciroli

Degree Level: Ph.D.

Keywords: Multi-Robot Systems, Human-Robot Interaction, Swarm Robotics, Human Factors, Augmented Reality

Description: Due to the potentially large number of units involved, the interaction with a multi-robot system is likely to exceed the limits of the span of apprehension of any individual human operator. In previous work, we studied how this issue can be tackled by interacting with the robots in two modalities — environment-oriented and robot-oriented. In this work, we study how this concept can be applied to the case in which multiple human operators perform supervisory control on a multi-robot system. While the presence of extra operators suggests that more complex tasks could be accomplished, little research exists on how this could be achieved efficiently. In particular, one challenge arises — the out-of-the-loop performance problem caused by a lack of engagement in the task, awareness of its state, and trust in the system and in the other operators. Through a user study involving 28 human operators and 8 real robots, we study how the concept of mixed granularity in multi-human multi-robot interaction affects user engagement, awareness, and trust while balancing the workload between multiple operators.

80. **Devdip Sen**

Flexible, Wearable, Wireless Health Care Monitoring Devices

Department: Electrical & Computer Engineering

Advisor: John McNeill

Degree Level: Ph.D.

Keywords: Health care, Flexible devices, Wearables, Wireless monitoring, Biosensors

Description: The prevalence of health care problems of at-risk patients and providing improved inpatient outpatient care has been a driving force to promote the required device technology in today's modern digital health care system. Giving medical professionals the ability to safely monitor patients remotely would grant freedom and comfort to the patients during their recovery phase. The development of new methods, along with the use of existing technology will allow patients to have better quality of life in the future.

81. **Yichuan Tang**

Three-Dimensional Co-Axial Photoacoustic Imaging System

Department: Robotics Engineering

Advisor: Haichong Zhang

Degree Level: Ph.D.

Keywords: Medical Device, Photo-acoustic, Medical Imaging, Mechanical Design, Mechatronics

Description: Conventional photoacoustic imaging system includes one ultrasound transducer and two laser light sources. Light sources and transducer do not share the same axis, which brought several inconvenience, like reduced image length and bulkiness of the entire imaging system. The project aims to implement a co-axial PA imaging system, and at the same time, enable three-dimensional PA imaging on the same device.

82. **Karim Tarabein**

Flexible steerable laser probe for office-based laryngeal interventions

Department: Robotics Engineering

Advisor: Loris Fichera

Degree Level: Ph.D.

Keywords: endoscopic, minimally invasive, laser surgery, office-based surgery, steerable

Description: The objective of this project is to create the first laser probe capable of controllable articulation for use in endoscopic laryngeal procedures. This research is motivated by the high prevalence of laryngeal pathology (1 in 40 people suffer from a benign laryngeal lesion at any given time) and the need for a non-surgical, cost-effective solution for the treatment of these conditions. Our new steerable laser probe will enable physicians to reach and treat anatomical locations that are normally inaccessible during office procedures, and potentially spare many patients the need for expensive surgical treatment.

83. **Vignesh Manoj Varier**

Automating suturing task for one of the da Vinci Research kit (dVRk) arms and learn the user's technique using Inverse Reinforcement Learning

Department: Robotics Engineering

Advisor: Gregory Fischer

Degree Level: Master's

Keywords: Inverse Reinforcement Learning, Surgical Robotics, Automation, Deep Learning, Suturing

Description: One of the main objectives of surgical robotics is to reduce the burden on the surgeon while providing them with added functionality. In order to relieve the stress and the burden on the surgeon while operating the da Vinci robot, semi automating or automating a trivial task such as suturing can be beneficial. This research project utilizes Inverse Reinforcement Learning to learn the surgeon's technique and then help assist the surgeon while performing the suturing task.

84. **Haopeng Wang**

Optimal Estimation of EMG Standard Deviation (EMG$\ddot{I}f$) in Additive Measurement Noise

Department: Electrical & Computer Engineering

Advisor: Edward Clancy

Degree Level: Ph.D.

Keywords: Additive manufacturing, SLA, InvestmentCasting

Description: Mathematical derivation of Gaussian and Laplacian models of EMG standard deviation, evaluate EMG probability density function, standard deviation estimates and probability of zero values at rest.

85. **He Wang**

Advanced Electromyogram Signal Processing with an Emphasis on Simplified, Near-optimal Whitening

Department: Electrical & Computer Engineering

Advisor: Edward Clancy

Degree Level: Master's

Keywords: Optical tweezrs, Cancer cells, Morphology, Temperature, Microtentacle

Description: Using whitening filter can substantially improven the estimation of the standard deviation of surface EMG signal. To simplify the existted subject-specific whitneing filter, a 60th-order "Universal" FIR whitening filter is calibrated by using 64 subjects' EMG data collected previously. Furthermore, a much simpler 2nd-order "Universal" IIR whitening filter is designed by implementing Differential evolution algorithm. Detials about the methods will be introduced, results will be shown with some discussion.

86. **Ziling Zhu**

Alternative estimation selection for EMG-Force model in Prosthetic control

Department: Electrical & Computer Engineering

Advisor: Edward Clancy

Degree Level: Ph.D.

Keywords: prosthesis, emg, control

Description: An electromyogram (EMG) is a neuromuscular signal and is widely applied to prosthetic control. For wrist & hand prosthesis, both EMG and corresponding force estimation should be recorded for EMG-Force linear regression model, which cannot satisfy amputees on their amputation (no corresponding force). Alternative estimations were tested either using the force generated by sound side in mirror movement, or directly using a target movement they follow by amputated side.

Chemical Engineering and Materials Science

87. **Mobin Vandadi**

Predicting the Cold Spray Process using Finite Element Analysis

Department: Civil Engineering

Advisor: Nima Rahbar

Degree Level: Ph.D.

Keywords: Cold Spray, FEM

Description: Cold spray process is about the impact of particles to a surface with a high velocity. Prediction and improving this process is an important part. Therefore, I have tried to due this using finite element analysis in ABAQUS software.

88. **Zhiru Zhou**

A Microfluidic Approach for Study of Vimentin Effect on Cell Motility

Department: Chemical Engineering

Advisor: H. Susan Zhou

Degree Level: PhD

Keywords: Mycobacteria, stress response, RNase E, mRNA degradation, RNA degradosome

Description: 1. We designed and developed an innovative microfluidic device, capable of high-resolution time-lapse imaging of cells migrating through 3D precisely controlled microchannel geometries mimicking physiological confined environments. 2. We demonstrated that knockdown of vimentin decreases 3T3 fibroblast cell directional migration speed in confined microchannels. 3. We observed different leading-edge morphology of 3T3 fibroblast and 3T3 vimentin knockdown cells during migration

89. **Cameron Armstrong**

Dynamic Catalytic Operation for Overcoming Inherent Barriers

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Ph.D.

Keywords: Catalysis, Pulsing, Microreactor, Reactions, Temperature Measurement

Description: 200 years of isothermal catalysis has led to a strong understanding of functional catalysis and material science, but has largely gone unchanged as a field. Transition to dynamic operation using microreactors has potential benefits in overcoming scaling linear relationships that limit catalytic activity. This work explores the effect that temperature pulsing on the millisecond scale has on this activity.

90. **Jacob Crislip**

Microfluidic Analysis of Zeolite Crystallization Kinetics

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Ph.D.

Keywords: Zeolites, Continuous Crystallization, Reaction Mechanism, Reactor Design, X-Ray Diffraction

Description: The zeolite crystal growth mechanism has remained a mystery despite decades of academic investigation. Applying reaction engineering principles to the design of a micro-scale flow reactor provides a high-resolution look into how the material is changing in real time.

91. **Lily Gaudreau**

Creation of an in vitro staphylococcal biofilm infection model for studying the host-pathogen interface and testing antimicrobials

Department: Chemical Engineering

Advisor: Elizabeth Stewart

Degree Level: Ph.D.

Keywords: Biofilms, Microfluidics, Staphylococci, Infection Model, Invitro

Description: Four of every 1000 ICU central venous catheter insertions results in a bloodstream infection, many of which are caused by biofilm formation on the catheter surface. In this study, our goal is to design and develop an in vitro infection-on-a-chip model that subjects a co-culture of a staphylococcal biofilm and tissue cells to growth conditions similar to those experienced by a bacterial biofilm formed on a catheter within a blood vessel. This model will serve as a platform for studying the bacteria-host cell interface and determining the effectiveness of novel antimicrobials.

92. **Jack Grubbs**

Comparing Traditional and Designer Alloy Feedstock Powders for Additive Manufacturing

Department: Materials Science & Engineering

Advisor: Danielle Cote

Degree Level: Ph.D.

Keywords: Additive manufacturing, Powder, Characterization, Modeling, Cold spray

Description: The traditional metal powders used in most additive manufacturing (AM) processes are not designed to allow for optimal properties in the processed part. Thus, designer powders may be used to bridge the gap in material processing and performance capabilities of traditional powders. Several traditional and designer powders were compared on the basis of morphology and composition to gain insight into potential advantages of designer feedstock materials for AM.

93. **Joseph Heng**

Model Analysis of Cellobiose Solubility in Organic Solvents and Water

Department: Chemical Engineering

Advisor: Michael Timko

Degree Level: Master's

Keywords: cellobiose, cellulose, solubility, modeling, thermodynamics

Description: Solubility data for cellobiose, a cellulose derivative, are presented for 19 solvents and modeled using three different methods. These models were analyzed to evaluate their ability to predict cellobiose solubility and to determine factors that make a good solvent for cellobiose.

94. **Kourosh Kian**

On-site Production of Hydrogen via Pd-Based Metallic Membranes with the Potential of Carbon Capture

Department: Chemical Engineering

Advisor: Jennifer Wilcox

Degree Level: Ph.D.

Keywords: Carbon dioxide, CO2 capture, Hydrogen, Membrane, Steam reforming

Description: This work is focused on the production of hydrogen as a clean energy using an alternative technology called membrane reactor, as well as capturing carbon dioxide as one of the most potent green house gases.

95. **Heather LeClerc**

Realizing a world without waste through catalytic hydrothermal liquefaction

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Ph.D.

Keywords: food waste, bio oil, biomass, waste to energy, catalysis

Description: Food waste is an urgent societal concern with millions of tons filling landfills annually. Hydrothermal liquefaction (HTL) is an emerging technology in the waste-to-energy field that uses high temperature and pressure to convert this waste into bio-oil. Catalysts with acid- base characteristics show promise in increasing bio-oil quality and yield when used in the HTL process.

96. **Shicheng Lyu**

Membraneless Water Purification via Diffusiophoresis

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Master's

Keywords: Tube-in-tube reactor, UV detector, Carbon dioxide, Particles, ion gradient

Description: The traditional way of water treatment is using membrane to filter the dirty water. Our project is using a diffusiophoresis principle to remove particles from dirty water through a tube-in-tube reactor. My poster will show our results and how our system works.

97. **Xiaotu Ma**

High Performance Graphite Recovered from Spent Lithium Ion Batteries

Department: Materials Science & Engineering

Advisor: Yan Wang

Degree Level: Ph.D.

Keywords: Graphite, Recycling, SpentLi-ionbatteries, Separation

Description: Due to the low added-value and rigorous separation steps, recycling and recovering graphite anode material is discarded. Although some direct physical recycling process has been reported, all of them are limited by rigorous separation steps and lab scale. A scalable recycling process for graphite anode materials from spent LIBs by hydrometallurgical process without separation steps is reported.

98. **Christopher Massar**

Optimization of Pre-heatreating Stainless Steel Powder for Cold Spray Aplications.

Department: Materials Science & Engineering

Advisor: Danielle Cote

Degree Level: Ph.D.

Keywords: Steel, Powder, Characterization, Heat, Treatment

Description: Stainless steel powder is heat-treated following a prescribed heat treatment based off of thermokinetic modeling. The idea of treating the powder will allow for increased deposition efficacy and better properties of the additively manufactured part.

99. **Yuhan Mei**

Ethanol decomposition via C-C Splitting on Rh(111) Surface in Room-temperature Liquid-phase

Department: Chemical Engineering

Advisor: Aaron Deskins

Degree Level: Ph.D.

Keywords: Density functional theory, Ethanol oxidation reaction, C-C bond splitting, Rhodium, Liquid phase

Description: Direct ethanol fuel cells (DEFCs) are a promising technology for the generation of electricity via the direct conversion of ethanol into CO2. Density functional theory (DFT) caluclations were performed to calculate reaction energies for ethanol decomposition on Rh(111) surface in vacuum and under liquid ethanol.

100. **Patryck Michalik**

Correlating pH with biofilm mechanics to determine the role of pH in staphylococcal biofilm disassembly and dispersal

Department: Chemical Engineering

Advisor: Elizabeth Stewart

Degree Level: Ph.D.

Keywords: Biofilms, microrheology, pHgradients, biofilmlifecycle, biofilmdisassembly

Description: Staphylococcal biofilms are frequently responsible for hospital-acquired and medical device associated infections. Here we examine the interaction between local pH gradients and mechanics in staphylococcal biofilms to fill a gap in the mechanistic understanding of how these biofilms form and breakdown. This study will inform the development of strategies for biofilm control and eradication, which will reduce biofilm infection rates within society.

101. **Aditya Moudgal**

Molten Salt Electrolysis Production of Solar Silicon from Natural Quartzite

Department: Materials Science & Engineering

Advisor: Adam Powell

Degree Level: Ph.D.

Keywords: Silicon, Electrometallurgy, Solar Energy, Phase Field Modelling, Energy

Description: Polysilicon production for photovoltaics (PV) via the dominant Siemens process is costly due to numerous unit operations, energy-intensity, and inherent safety problems. Molten salt electrolysis reduction of silica could potentially achieve similar energy use and cost to the Hall-Héroult process which produces the world's aluminum, i.e. 90% lower energy use and 80% lower cost vs. the Siemens process. The poster will describe experimental and modeling work to engineer a silicon reduction process using molten salt electrolysis. The process produces solid silicon using periodic current reversal to suppress cathodic instabilities.

102. **Mahya Shahabi**

Utilization of nonstandard powders with irregular morphology in powder bed fusion additive manufacturing of 17-4 PH Stainless Steel

Department: Materials Science & Engineering

Advisor: Sneha P. Narra

Degree Level: Ph.D.

Keywords: Water atomized powder, gas atomized powder, laser powder bed fusion, additive manufacturing, porosity

Description: Powder costs is one of the major cost contributors in metal additive manufacturing (AM). A possible way to reduce these costs is by using relatively cheaper powders compared to the ones that are currently used. In this work, we investigated the use of water atomized powders with irregular (non-spherical) morphology. Optimal processing conditions were developed to achieve part density that is comparable to samples fabricated with standard spherical powders that are relatively more expensive than water atomized powders. This work demonstrates the possibility to use alternate irregular morphology powders in metal AM.

103. **Bryer Sousa**

High-Throughput Nanomechanical Characterization at WPI

Department: Materials Science & Engineering

Advisor: Danielle Cote

Degree Level: Ph.D.

Keywords: Nanoindentation, Metallurgy, Mechanics

Description: With advancements in rapid prototyping and the need for data-driven solutions for the qualification of a newly tested design or material system, the demand for novel and high-throughput characterization technologies has grown. This work will showcase the way in which nanoindentation is being employed for the purpose of addressing high-throughput characterization needs with respect to the mechanical behavior of metallurgical materials and components.

104. **Panawan Vanaphuti**

Enhanced Electrochemical Performance of Lithium, Manganese-Rich Cathode for Li-ion Batteries

Department: Materials Science & Engineering

Advisor: Yan Wang

Degree Level: Ph.D.

Keywords: Lithium-Ion Batteries, Doping, Cathode, Performance, High Energy Density

Description: Due to the large demand of electric vehicles and grid energy storage systems, many ongoing researches are focusing on the improvement of energy density, capacity, cycling stability and rate performance of Li-ion batteries. Lithium, Manganese-rich layered oxide cathode (LMR-NMC) is one of the promising cathode materials for the near future owing higher energy density over traditional cathode materials. Nevertheless, the capacity fading and voltage fading during cycling are still the major obstacle to the commercialization of LMR-NMC in battery applications. Here, doping technique is applied in order to overcome these issues.

105. **Ziqi Wei**

Study of Collagen Tethered Antimicrobial Peptide Binding and Antimicrobial Activity

Department: Chemical Engineering

Advisor: Terri Camesano

Degree Level: Ph.D.

Keywords: Collagen binding, Antimicrobial peptides, LL37, Chronic wound healing,

Description: Recent work from our lab has demonstrated that collagen tethering of antimicrobial peptides (AMPs) using collagen-binding domains (CBDs) has potential in delivering novel, non-cytotoxic, antimicrobial, and pro-healing therapies to chronic wounds and will not promote bacterial resistance. The goal of this project is to study collagen film deposition and to observe antimicrobial activity on E. coli in quartz crystal microbalance with dissipation monitoring (QCM-D).

106. **Yao Xu**

Magneto-mechanical model for a polycrystalline ferromagnetic shape memory alloy

Department: Materials Science & Engineering

Advisor: Sneha Narra

Degree Level: Ph.D.

Keywords: Ferromagnetic shape memory alloy, Functional material, NiMnGa, Twin boundary motion, Magnetic field induced strain

Description: Ferromagnetic shape memory alloys such as NiMnGa demonstrate up to 10% magnetic field induced strain because of the high mobility of the twin boundaries in the martensitic phase. In this work, the twin boundary motion is modeled to understand and quantify the effect of microstructure such as grain size, shape, and orientation. This model can be used to tailor the magnetic field induced strain with potential applications such as precise positioning and active vibration control in helicopters.

107. **Tao Yan**

Atomic and Electronic Structure of the Edges of Multilayer and Monolayer Tin Disulfide (SnS2)

Department: Materials Science & Engineering

Advisor: Pratap Rao

Degree Level: Ph.D.

Keywords: 2D material, Semiconductors, Atomic structure, Electronic structure, Catalysts

Description: Because of its two-dimensional structure and semiconducting properties, tin disulfide (SnS2) is of interest for applications in electrochemical catalysis and sensing, as an electron transport layer for photovoltaics, and as an active material in photodetectors and thin film transistors. While the atomic and electronic structure of the basal planes of bulk and monolayer SnS2 are well known, the same is not known for the edges, which could have a major influence on the performance of SnS2 in the aforementioned applications. This paper reports on density functional theory (DFT) simulations and experimental measurements of the atomic and electronic structure of the edges of multilayer and monolayer SnS2 under different chemical conditions. We found that the band gap of the SnS2 edges becomes smaller with increasing sulfur coverage, and thereby determined the influence of chemical synthesis conditions on the electronic structure of the edges. We also found that as-synthesized SnS2 has unpaired electrons at the edges, which suggests a direction to solve the degradation issue of SnS2 as a catalyst in aqueous electrolytes.

108. **Yuhan Yang**

Diffusional Limitation in Solid Phase Peptide Synthesis

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Master's

Keywords: Diffusion limitation, Peptide Synthesis, Amino Acid, Dimethyl formamide

Description: On-demand peptide synthesis has a great effect on personalized medicine, while current technology of flow chemistry require an excess of products and wasteful solvent washes. By analysis, we found that previous methods of peptide synthesis had barriers mainly caused by incorrect uses of amino acid. This project works on reducing the product and energy demand of the synthesis process, and we hypothesize the resin used to load amino acid for producing peptide contains diffusion limitation. The project tests the hypothesis to prove as well as find the main cause of slow amino acid uptake and coupling time. Based on the test, main factors will be engineered in order to improve the efficiency for a green process of peptide synthesis.

109. **Ziyang Zhang**

Investigating Cellulose-Solid Acid Catalyst Colloid Interaction for Cellulose Depolymerization

Department: Chemical Engineering

Advisor: Michael T. Timko

Degree Level: Ph.D.

Keywords: traffic estimation, generative model, urban planning, urban big data analysis, spatial data analysis

Description: This work first theoretically examines the colloid interaction of cellulose with solid acid catalysts (e.g. ZSM5, amberlysts, vinyl sulfonic acid char) for cellulose hydrolysis. Then attempts are made to enhance cellulose-catalyst adsorption by using polycation or other solvents with low surface tension to improve the glucose yield.

110. **Yubin Zhang**

Amorphous Sr-doped LLTO as solid electrolyte and interfacial nanocoating

Department: Materials Science & Engineering

Advisor: Yan Wang

Degree Level: Ph.D.

Keywords: Cellulose depolymerization, Heterogeneous, Renewable energy, Colloid, adsorption

Description: In this study, we successfully synthesized amorphous LLSTO (Li0.35La0.5Sr0.05TiO3) as solid electrolyte for Li-ion battery, the ionic conductivity was increased by almost one order, and still comes with good stability with Lithium metal. Furthermore, With a facile wet chemical approach, we coated a thin layer of amorphous LLSTO with 15−20 nm at the interface between NMC and Li6PS5Cl. Attributed to the high stability of Li6PS5Cl with NMC/LLSTO and outstanding ionic conductivity of the LLSTO and Li6PS5Cl, at room temperature, the ASLBs exhibit outstanding capacity of 107 mAh g−1 and keep stable for 850 cycles with a high capacity retention of 91.5% at C/3 and voltage window 2.5−4.0 V (vs Li−In).

111. **Tongjie Zhang**

Production and Recovery of Organics from Degraded Waste Marine Plastics Using Subcritical Water

Department: Chemical Engineering

Advisor: Michael Timko

Degree Level: Master's

Keywords: Multiple agents, Imitation Learning, Inverse Reinforcement Learning, Generative Adversarial Imitation Learning, Generative Adversarial Network

Description: The hydrothermal liquefaction method in degrading marine plastics. The phase behavior study of fatty acids.

Data Science, Cybersecurity, and Computer Science

112. **Noelle Rakotondravony**

Studying verbalizations of data visualizations in multiple languages

Department: Computer Sciences

Advisor: Lane Harrison

Degree Level: PhD

Keywords: Data visualization, natural languages, crowdsourcing, Data visualization

Description: Data visualizations are widespread tools that help people understand and communicate their data in many aspects of their life. Our research compares the verbalizations in different languages of visually encoded data. Findings will be used towards defining methodologies for designing effective visualization and communication of data for multicultural or multilingual environments.

113. **Abdulaziz Alajaji**

DeepContext: Attention-Based CNN for Human Context Recognition

Department: Data Science

Advisor: Emmanuel Agu

Degree Level: Ph.D.

Keywords: Ubiquitous and mobile computing, Context-aware computing, Human context recognition, Deep-learning, Context

Description: As part of our DARPA-funded Warfighter Analytics for Smartphone Healthcare (WASH) project, we aim to determine a user's context from sensor data gathered passively from smartphones. We focus on recognizing specific user contexts in which high-specificity health assessments for Traumatic Brain Injury (TBI) and infectious diseases can be performed on monitored smartphone users.

114. **Marissa Bennett**

Improving Neural Network Performance with Robust PCA

Department: Computer Science

Advisor: Randy Paffenroth

Degree Level: Master's

Keywords: Machine Learning, Dimension Reduction, Cyber Defense, Toolchain, Robust PCA

Description: What if there was a tool that could take a data set used for machine learning, and manipulate that data set in such a way, that the accuracy of the machine learning model is improved? I will be going behind the math, and elements of the toolchain responsible for this, and some applicable data set examples.

115. **Luke Buquicchio**

VOSR: Variational Open-Set Recognition

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: machine learning, open-set classificaiton, image classificaiton, variational autoencoders, Gaussian mixtures

Description: Traditional classifiers are trained under the closed-set assumption, meaning that all classes present during training are all classes that can exist after training. Conversely, models trained under the open-set assumption expect new classes of data after training and attempt to meaningfully reject unknown data. We propose the Variational Open-Set Recognition (VOSR) method that uses a novel Multi-Modal Variational Autoencoder (MMVAE) to achieve open-set classification.

116. **Zorigtbaatar Chuluundorj**

Towards Usable Whitelists

Department: Computer Science

Advisor: Craig Shue

Degree Level: Ph.D.

Keywords: Network Security, Intrusion Detection System, Dynamic Whitelists, User interaction monitoring, Cybersecurity

Description: Constructing a list of trustworthy network destinations, whitelists, is difficult due to the dynamic nature of modern software. We aim to overcome this difficulty by monitoring the interaction between the end-user and software to predict network activity.

117. **Yiren Ding**

Quantifying and Modeling how well Motion Visualizations Communicate Data

Department: Computer Science

Advisor: Lane Harrison

Degree Level: Ph.D.

Keywords: Motion, Data Visualization, Modeling, Charts, Online Experiment

Description: Animation and movement are widely used in modern data visualizations, for example, to communicate the speed and direction of wind in engaging and informative ways. At a lower level, the animation uses motion channels (such as movement, rotation, and vibration) to encode data values. This poster presents a study examining how well people can retrieve data values from animations and a comparison of the utility and expressiveness of commonly used techniques.

118. **John Erickson**

The Automated Grading of Student Open Responses in Mathematics

Department: Data Science

Advisor: Neil Heffernan

Degree Level: Ph.D.

Keywords: open responses, automatic grading, natural language processing, word embedding, machine learning

Description: This research explores the viability and challenges of developing automated graders of open-ended student responses in mathematics. We further explore how the scale of available data impacts model performance. Focusing on content delivered through the ASSISTments online learning platform, we present a set of analyses pertaining to the development and evaluation of models to predict teacher-assigned grades for student open responses.

119. **Walter Gerych**

Deep Sequential Positive Unlabeled Learning Under Biased Labeling

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Deep learning, machine learning, positive unlabeled, recurrent network, biased labeling

Description: Positive Unlabeled (PU) learning is a subclass of binary classification in which a subset of the positive training instances and all negative instances are unlabeled. PU data arises infields from medical records to Human Activity Recognition (HAR). State-of-the-art PU methods assume that the likelihood of an instance being labeled is either constant or a simple function of the local attributes of the instance. However,in many applications, including in HAR studies in which participants annotate their own data as it is being collected using a smartphone, subjects label long sequences or bursts of activity in one shot. In this work, we formalize this new bursty (un)labeling pattern as the Sequentially Selected at Random (Seq-SAR) assumption. We then propose the first framework for learning the true class prob-abilities under this new Seq-SAR assumption.

120. **Guin Gilman**

Challenges and Opportunities of DNN Model Execution Caching

Department: Computer Science

Advisor: Robert Walls

Degree Level: Ph.D.

Keywords: deep learning, caching algorithms, GPGPU, memory management, paging

Description: While GPUs are commonly used to accelerate the execution of deep learning models, the GPU's performance is often limited by the efficiency of its memory management techniques. We examine the efficiency of a paged memory management scheme with neighborhood-aware pre-fetching to increase GPU performance for deep learning models.

121. **Tom Hartvigsen**

Selective Activation for Recurrent Neural Networks

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: deep learning, sequence modeling, adaptive computation

Description: Recurrent Neural Networks (RNN) are the state of the art solution to a wide variety of machine learning problems for sequential data. However, they are computationally expensive and notoriously challenging to optimize. We propose a novel method for reducing computation in RNNs that learns to predict which dimensions of the RNN's hidden state to update at each step of an input sequence.

122. **Han Jiang**

Automatic detection and identification of math problems in videos

Department: Data Science

Advisor: Jacob Whitehill

Degree Level: Ph.D.

Keywords: Object Detection, Yolo, Hand written recognition, Deep Neural Network, Math problems embedding

Description: There are millions of online math tutorial videos from which students can learn. It would be useful to help students find the ones that are most relevant to their current learning challenges. We propose an approach based on computer vision. In particular, we train a model to detect the math characters, use the automated detections in an embedding function, and then compare the similarity of embeddings between different videos.

123. **Julian Lanson**

Single-Use Servers: Exploring the Confused Deputy Problem in Networked Services

Department: Computer Science, Computer Security

Advisor: Craig Shue

Degree Level: Master's

Keywords: Confused deputy, Access control instrumentation, Containerization, Attack attribution, Network security

Description: We present the Single-Use Server (SuS) model, a system that neutralizes Confused-deputy-based exploitation of networked services. We implement the SuS model for Wordpress, a popular software for website development, and demonstrate that it successfully defends against multiple confused-deputy attacks. Whereas previous work focuses exclusively on defending LAMP-stack web servers, we explore similarities between HTTP and other client-server protocols (IMAP, SSH, NFS, etc.) to develop a generalized model that can be applied in many services.

124. **Yunsen Lei**

Towards Better Kernel and Network Monitoring of Software Actions

Department: Computer Science, Computer Security

Advisor: Craig Shue

Degree Level: Ph.D.

Keywords: security, monitoring, software, network, kernel

Description: A security system is only as good as its monitoring mechanism. Software, as one of the most common attack vector that an attacker can gain access to the system is usually the monitoring target. Therefore, a better understanding of the actions in software is crucial for building a monitoring system that can efficiently detect attacks. In this work, we address the problems in the current monitoring system from multiple perspectives and propose different approaches to mitigate these issues.

125. **Zeqian Li**

Compositional Embeddings: Joint Perception and Comparison of Class Label Sets

Department: Computer Science

Advisor: Jacob Whitehill

Degree Level: Ph.D.

Keywords: optical sensor, moisture measurement, fiber optics, food processing

Description: We explore the idea of compositional set embeddings that can be used to infer not just a single class, but the set of classes associated with the input data (e.g., image, video, audio signal).

126. **Ziyang Liu**

application of deep learning model to wound assessment

Department: Computer Science

Advisor: Emmanuel Agu

Degree Level: Ph.D.

Keywords: deep learning, computer vision, wound assessment, chronic wounds, PWAT score

Description: PWAT, the Photographic Wound Assessment Tool, is a wound assessment system based on wound images and can estimates how serious a wound is. PWAT grades score for the wound in an image and PWAT contains 8 subscores and a range of [0, 1, 2, 3, 4] for each subscore. Our goal is to train deep learning models to estimate all the PWAT subscores from wound images.

127. **Yu Liu**

Account Lockouts: Characterizing and Preventing Account Denial-of-Service Attacks

Department: Computer Science

Advisor: Craig Shue

Degree Level: Ph.D.

Keywords: Account Lockout, Denial-of-Service, Single Sign-On, Middlebox, Measurement

Description: To stymie password guessing attacks, many systems lock an account after a given number of failed authentication attempts, preventing access even if proper credentials are later provided. Combined with the proliferation of single sign-on providers, adversaries can use relatively few resources to launch large-scale application-level denial-of-service attacks against targeted user accounts by deliberately providing incorrect credentials across multiple authentication attempts. We measure 2,066 organizations and found between 58\% and 77\% of organizations expose authentication portals that are vulnerable to account lockout attacks. Such attacks can be completely successful with only 13 KBytes/second of attack traffic. We then propose and evaluate a set of lockout bypass mechanisms for legitimate users. Our performance and security evaluation shows these solutions are effective while introducing little overhead to the network and systems.

128. **Yingnan Liu**

Ensemble CNN in frequency domain for single image super-resolution

Department: Data Science

Advisor: Randy Paffenroth

Degree Level: Ph.D.

Keywords: Concentration Parameter, Discrete Baseline, Empirical Study, Grid Method, Nonparametric Bayesian Statistics

Description: We developed methods for recovering high-resolution images from low-resolution images by combining ideas inspired by sparse-coding, such as compressive sensing techniques, with super-resolution neural networks. In particular, we ensemble models in different frequency domains to achieve a robust optimal solution for various types of images.

129. **Hamid Mansoor**

DELFI: Mislabelled Human Context Detection Using Multi-Feature Similarity Linking

Department: Computer Science

Advisor: Emmanuel Agu

Degree Level: Ph.D.

Keywords: Data Visualization, Context Data, Smartphone, Mislabeled Data, Context-aware Systems

Description: Collecting human behavior data through smartphones enables us to build robust "context-aware" systems such as self driving cars or digital assistants. However such data may be mislabeled which makes it difficult to build accurate context aware systems. We use innovative data visualization techniques to enable analysts to find mislabeled smartphone-gathered human context data and improve the quality of such datasets.

130. **Christopher Micek**

Bridging the Divide: Creating Friendlier Digital Spaces in the Post-Truth Era

Department: Computer Science

Advisor: Erin Solovey

Degree Level: Ph.D.

Keywords: empathy, social computing, AI

Description: The current hyper-polarized political and media landscape has colored the interactions between users of online communication platforms, blurring the line between fact and fiction and charging discussions with tribalism and emotion. This research explores ways digital spaces might be altered to diffuse these tensions and increase the empathy of users.

131. **Samuel Ogden**

ModiPrep: Improving Cloud-based CNN Inference Performance for Mobile Applications

Department: Computer Science

Advisor: Tian Guo

Degree Level: Ph.D.

Keywords: Deep Learning, Mobile Applications, Performance Optimization, Cloud Computing, Convolution Neural Networks

Description: The variability inherent in mobile execution, both from device capabilities and network conditions, can lead to large delays and poor user experience for mobile users of deep learning-based applications. In this work we introduce a system for dynamically selecting preprocessing location in order to both decrease execution time and improve accuracy.

132. **Sarun Paisarnsrisomsuk**

Improved Deep Learning Architecture for Classification of Human Sleep Stages

Department: Computer Science

Advisor: Carolina Ruiz

Degree Level: Ph.D.

Keywords: Deep learning, human sleep, polysomnography, feature visualization

Description: We developed deep convolutional neural networks (CNNs) performing a sleep stage classification from human sleep EEG and EOG signals. We trained and evaluated the performance of CNN architectures on unseen patients by using a nested cross-validation method. By applying t-Distributed Stochastic Neighbor Embedding (t-SNE) technique to the responses of internal layers of our networks, we visualized how the sleep stage specialization is developed over the layers.

133. **Menghai Pan**

Explaining Passenger-seeking Strategies of Taxi Drivers via xGAIL

Department: Computer Science

Advisor: Yanhua Li

Degree Level: Ph.D.

Keywords: explainable artificial intelligence, imitation learning, data mining, machine learning, urban computing

Description: The poster is a research project explaining the passenger-seeking strategies of taxi drivers by analyzing their historical trajectory data. The method employed is the explainable generative adversarial imitation learning.

134. **Aleksa Perucic**

Reference Shapelets for Irregularly-Sampled Time Series

Department: Computer Science

Advisor: Elke Rundensteiner

Degree Level: Master's

Keywords: Deep Learning, Interpolation, Multivariate, Time Series, Irregular Data

Description: Physiological time series data found in electronic health records is often sparse, irregularly sampled, and multivariate. We propose a new method of multivariate time series interpolation and classification. The proposed method aims to improve upon existing methods by determining which parts of the time series are relevant to the classification model.

135. **Ethan Prihar**

Providing Additional Instruction to Students via Reinforcement Learning

Department: Data Science

Advisor: Neil Heffernan

Degree Level: Master's

Keywords: Online Tutoring, Reinforcement Learning, Educational Data Mining, Machine Learning, Contextual Bandits

Description: The ASSISTments Lab has partnered with Pennsylvania State University and University of Arkansas to create "Just-in-Time Instruction" for struggling students. After identifying YouTube videos relevant to K-12th grade math topics, the ASSISTments platform uses reinforcement learning to provide struggling students with the video that will have the greatest impact to their understanding of the topic.

136. **Huimin Ren**

Taxi driver identification

Department: Data Science

Advisor: Yanhua Li

Degree Level: Ph.D.

Keywords: siamese network, spatiotemporal data, taxi driver identification

Description: In this project, we propose an innovative approach to identify taxi drivers based on trajectories. We split the trajectories into seeking customers trajectories and serving customers trajectories for each driver in each day. And then we compare these two types of trajectories for each driver on different days to see if those trajectories belong to the same driver.

137. **Allison Rozet**

Shared Complex Event Trend Aggregation

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: stream processing, multi-query optimization, event trend, incremental aggregation, complex event processing

Description: Streaming analytics deploy Kleene pattern queries to detect and aggregate event trends against high-rate data streams. We are the first to propose a novel framework, MUSE (Multi-query Snapshot Execution), that shares aggregation queries with Kleene patterns while avoiding expensive trend construction. Our experiments over a wide range of scenarios demonstrate that MUSE achieves up to a 25-fold increase in throughput compared to state-of-the-art approaches while also staying competitive in memory usage.

138. **Suhas Srinivasan**

Revealing Tumor Heterogeneity in Triple-negative Breast Cancer at Single-cell Resolution

Department: Data Science

Advisor: Dmitry Korkin

Degree Level: Ph.D.

Keywords: Triple-negative Breast Cancer, Single-cell RNA Sequencing, Tumor Heterogeneity, Deep Learning, Artificial Intelligence

Description: Triple-negative breast cancer (TNBC) is known for its tumor heterogeneity. TNBC is associated with poor survival prognosis due to its aggressiveness and lack of effective therapies. In this study, we examined primary untreated TNBC tumors using single-cell RNA-seq data. Our novel artificial intelligence approach revealed cancer clones that were accentuated with copy number variation and high expression of breast cancer associated genes.

139. **Jidapa Thadajarassiri**

Similarity-Preserving Meta-Embedding (SimME)

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Integrated embedding, Semantic preservation, Representation learning, Meta embedding, Relation encoder

Description: We present a simple, yet novel, learning method, named SimME, to encode semantic information from multiple publicly available embeddings into one integrating embedding.

140. **Monica Tlachac**

Patient Data Generation

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Deep Learning, Machine Learning, Health Informatics, Generative Models, Data Anonymization

Description: Machine learning has great potential to improve healthcare. However, due to privacy concerns, large quantities of patient data are not publicly available to train the models. Our research is focused on leveraging deep learning to generate patient data with no privacy concerns.

141. **Thanh Tran**

Adversarial Mahalanobis Distance-based Attentive Song Recommender for Automatic Playlist Continuation

Department: Data Science

Advisor: Kyumin Lee

Degree Level: Ph.D.

Keywords: music recommendation, adversarial loss, metric learning, adversarial bayesian personalized ranking, metric-based attention

Description: We aim to solve the automatic playlist continuation (APC) problem by modeling complex interactions among users, playlists, and songs using only their interaction data. Prior methods mainly rely on dot product to account for similarities, which is not ideal as dot product is not metric learning, so it does not convey the important inequality property. Based on this observation, we propose three novel deep learning approaches that utilize Mahalanobis distance. Our first approach uses user-playlist-song interactions, and combines Mahalanobis distance scores between (i) a target user and a target song, and (ii) between a target playlist and the target song to account for both the user's preference and the playlist's theme. Our second approach measures song-song similarities by considering Mahalanobis distance scores between the target song and each member song (i.e., existing song) in the target playlist. The contribution of each distance score is measured by our proposed memory metric-based attention mechanism. In the third approach, we fuse the two previous models into a unified model to further enhance their performance. In addition, we adopt and customize Adversarial Personalized Ranking (APR) for our three approaches to further improve their robustness and predictive capabilities. Through extensive experiments, we show that our proposed models outperform eight state-of-the-art models in two large-scale real-world datasets.

142. **Jean-Baptiste Truong**

Providing User-Controlled Privacy and Model Confidentiality with On-Device Deep Learning

Department: Computer Science

Advisor: Robert J Walls

Degree Level: Master's

Keywords: Deep, learning, Confidentiality, Privacy, Mobile

Description: We are trying to address the user's data privacy in deep learning applications by running the model directly on the user's device. Doing so requires the model providers to execute their proprietary models on the untrusted device. Our goal is to keep this asset confidential by developing new techniques called model partitioning.

143. **Ashvini Varatharaj**

Text or Speech? Assessing Fluency and Accuracy of Speech Among Chinese Language Learners

Department: Computer Science

Advisor: Neil Heffernan

Degree Level: Master's

Keywords: Audio data, Education, Language Learning tool, User-study, AI

Description: Helping students learn Chinese as a second language with the help of Machine learning.

144. **Matthew Weiss**

The Autoencoder Kalman Filter: Theory and Practice

Department: Data Science

Advisor: Randy Paffenroth

Degree Level: Ph.D.

Keywords: Kalman Filter, Deep Learning, State Estimation, Domain Randomization

Description: We employ a deep learning-state estimation hybrid algorithm called the Autoencoder-Kalman Filter (AEKF) to learn a mapping from noisy measurements to inputs for the Kalman Filter. Training the AEKF uses a technique called domain randomization, where the AEKF has been shown to achieve superior state estimation compared with a standard Kalman Filter and a LSTM neural network on a variety of noise types.

145. **Pitchaya Wiratchotisatian**

Matching Students to Project Centers: Stability, Efficiency, and Cohort Considerations

Department: Data Science

Advisor: Andrew C Trapp

Degree Level: Ph.D.

Keywords: Integer Optimization, Resource Allocation, Algorithm

Description: Global projects are a cornerstone of the project-based curriculum at Worcester Polytechnic Institute (WPI). We propose an optimization-based mechanism to help the WPI's Interdisciplinary and Global Studies Division (IGSD) assigning students to project centers. Our model finds stable and efficient solutions, and seeks to satisfy cohort considerations for project centers.

146. **Yingxue Zhang**

TrafficGAN: Off-Deployment Traffic Estimation with Traffic Generative Adversarial Networks

Department: Data Science

Advisor: Yanhua Li

Degree Level: Ph.D.

Keywords: robocastiing, process control, product quality, ceramic, additive manufacturing

Description: We are aiming to foresee the traffic condition changes of a region prior to the deployment of a construction plan. This problem is important to city planners when evaluating urban deployment plans. So we propose a new model called TrafficGAN which can provide promising estimations of future traffic before the urban constructions.

147. **Dongyu Zhang**

BERT-based Hierarchical Architecture for Document Series Classification

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: amorphous, solid electrolyte, interfacial nanocoating, ionic conductivity, stability

Description: A patient's clinical notes correspond to a sequence of free-form text documents generated by health care professionals over time, with each note in turn containing a sequence of words. In this work, we propose a BERT-based hierarchical architecture for classifying document series. We first encode clinical notes of a patient through a Bidirectional Encoder Representation from Transformer (BERT), then feed them into a recurrent neural architecture to get patient-level classification results..

148. **Liang Zhang**

CorDsDB: Pattern-based Correlation Exploitation in Big Partitioned Data Series Data

Department: Data Science

Advisor: Mohamed Y. Eltabakh

Degree Level: Ph.D.

Keywords: big data, time series, pattern, data series, similarity search

Description: Distributed Indexing framework support index and search large-sale high-dimensional data series based on the correlation with meta attributed ignored usually.

149. **Xin Zhang**

Asynchronous Multi-Agent Generative Adversarial Imitation Learning

Department: Data Science

Advisor: Yanhua Li

Degree Level: Ph.D.

Keywords: BERT, Document Series Classification, Hierarchical Structure, LSTM, Clinical Notes Processing

Description: This poster introduces asynchronous multi-agent generative adversarial imitation learning. This work is set in multi-agent games where players are designated certain orders to take an action. Examples are chess game where two players take turns to play a game and etc. In this work, we have proposed an imitation learning strategy that is able to reach sub-game perfect equilibrium in these games.

150. **Yiqin Zhao**

Efficient Lighting Estimation for Mobile Augmented Reality

Department: Computer Science

Advisor: Tian Guo

Degree Level: Master's

Keywords: Geopolymer, chemicaldeformation, FTIR, XRD, ICP-MS

Description: We design efficient neural network architecture and system for lighting estimation problem for mobile augmented reality. Our research enhanced the augmented reality user experience by efficiently matching environment lighting and rendering realistic virtual objects.

Mathematical, Chemical, and Physical Sciences

151. **Guillermo Carlo Nunez Ponasso**
Morphisms of Skew Hadamard Matrices
Department: Mathematical Sciences
Advisor: Padraig O Cathain
Degree Level: Ph.D.
Keywords: Hadamard matrices, Combinatorics, Algebra, Communications, CodingTheory
Description: Hadamard matrices have a wide range of applications in many different fields such as statistics, communications and coding theory. In our poster we present a method of constructing an infinite family of Hadamard matrices and conditions for nonexistence of certain complex Hadamard matrices.

152. **Teagan Bate**
Enhancing the control of microtubule active gel using DNA bound kinesin clusters
Department: Physics
Advisor: Kun-Ta Wu
Degree Level: Ph.D.
Keywords: Microtubule, Kinesin, Active Gel, DNA, Temperature Gradient
Description: Our research objective is to further the methods of controlling microtubule-based active fluids with temperature. To reach this objective, we conjugated kinesin motors with DNA. The temperature response of DNA allows us to control the power output of kinesin motors and associated activity of the active fluid. Because temperature controls activity, the active fluid was placed on a temperature gradient to elucidate how active fluid self-organizes in a non-homogeneous activity environment.

153. **Sathwik Bharadwaj**
Versatile Multiscale Envelope Function Formalism for Quantum Transport
Department: Physics
Advisor: L. Ramdas Ram-Mohan
Degree Level: Ph.D.
Keywords: Two dimensional materials, Electron transport, Thermoelectricity, Optoelectronic devices, Defect scattering
Description: Accurate determination of current transport properties in two dimensional materials is crucial for technological applications. We have developed algorithms to simulate high-performance devices in such materials to be applied in solar energy conversions, wearable electronics, and quantum computers. Our research will guide the futuristic technologies and nano-fabrication industries.

154. **Xinyu Chen**

Order-Restricted Bayesian Estimation of Multinomial Counts for Small Areas

Department: Mathematical Sciences

Advisor: Balgobin Nandram

Degree Level: Ph.D.

Keywords: atomic force microscopy, mechanosensation, mechanoreception, neuron, drosophila

Description: We consider making inference about several small areas with data obtained in the form of multinomial counts. The cell probabilities have the same unimodal order restriction across areas. We show how to perform the Bayesian inference because there are difficulties poised by the order restrictions.

155. **Jiazhang Chen**

Investigation of mechanosensation in drosophila larvae: dendritic arborization neurons response to local mechanical stimulation

Department: Physics

Advisor: Qi Wen

Degree Level: Ph.D.

Keywords: Single particle ICP-MS, Wastewater, Inorganic nanoparticles, WWTP, Nanoparticle characterization

Description: Mechanosensation is a diverse and essential phenomenon in cell biology, from very old age till today, from bacteria to mammals. Cells sense forces applied on and respond to them to help animal survive. As a model organism, drosophila melanogaster is a well-suited animal that provides samples in research of mechanosensation. In this research we used atomic force microscope, a well-developed tool to deliver nanonewton-range force and micrometer-range size in order to investigate the response of neurons on single dendrite branches. The property of neuronal response to this local mechanical stimulation in vivo may help us to reveal the mechanism of mechanosensation.

157. **Yang Liu**

Sampling Methods for the Concentration Parameter of the Dirichlet Process

Department: Mathematical Sciences

Advisor: Balgobin Nandram

Degree Level: Ph.D.

Keywords: CNN, super-resolution, image, frequency domain, Ensemble

Description: Dirichlet process is very flexible and determines the complexity of the model; it is indexed by two hyper-parameters: the baseline distribution and concentration parameter. Current sampling methods for the concentration parameter only consider the continuous baseline distribution; we will review them and propose a new method based on the uniform of ratios. We also raise a question for the discrete baseline distribution and present a solution to it.

158. **Elisa Negrini**

Differential Equation Recovery Using Machine Learning

Department: Mathematical Sciences

Advisor: Luca Capogna

Degree Level: Ph.D.

Keywords: Differential Equations, Inverse Problems, Machine Learning, Deep Learning

Description: We investigate the problem of learning an equation directly from some given data. The main idea is to use machine learning algorithms, and specifically recurrent neural networks, to recover the underlying physical equations that govern the structure of the phenomena. We also provide necessary conditions for the stability of our algorithm.

159. **Anusuya Pal**

Pattern Formation in Drying Droplets of Human Blood: A Diagnostic Marker?

Department: Physics

Advisor: Germano S. Iannacchione

Degree Level: Ph.D.

Keywords: drying, patterns, human blood, diagnostics, droplets

Description: Patterns evolved in the drying droplets of any biological serum has a potential application in medical and forensic fields. Though the full fundamental understanding is still far to achieve, this area becomes challenging and exciting for many researchers. In this presentation, the time evolution and resulting morphological patterns are studied in human blood serum and linked to the initial state of the constituent particles.

160. **Lynnette Robinson**

Optimizing Electromagnetically Driven Heat Transfer through Composition Gradients

Department: Mathematical Sciences

Advisor: Burt Tilley

Degree Level: Ph.D.

Keywords: Wireless power transmission, Electromagnetic fields, Thermal runaway, Optimization, Heat transfer

Description: Applications such as beamed energy propulsion uses generated heat energy and transfers it into work in order to send power to a different location. Lossy materials are an example of something that absorb electromagnetic waves to contribute to this process. With the ordinary differential equation model that we are solving in MATLAB, we will be able to measure the electric field within the material with varying temperature profiles. This allows us to look at the relationship between the conductivity and temperature of the lossy material in order to determine the properties a composite would have to have in order to transfer the position of maximized heat transfer. We will be comparing analytic, computational, and simulation results.

161. **Patchara Santawisook**

Price impact of VIX futures

Department: Mathematical Sciences

Advisor: Stephan Sturm

Degree Level: Ph.D.

Keywords: price impact, VIX futures, ETF, ETN, Volatility

Description: We estimate price impact of VIX futures and investigate whether the daily "rolling" process of VIX ETFs/ETNs products affect their underlying asset (VIX futures), especially 4:00 - 4:15 PM.

162. **Steven Vandal**

Kinesin-1 motor accumulation onto microtubules gliding over lipid bilayers

Department: Physics

Advisor: Erkan Tüzel

Degree Level: Ph.D.

Keywords: Molecular motors, Cytoskeletal filaments, Biophysics, Computer simulation, Coarse-grained modeling

Description: Molecular motors walk along cytoskeletal filaments to transport cargo throughout the cell and reorganize the cytoskeletal network. Here, we model the rate of accumulation of motors bound to a lipid membrane onto cytoskeletal filaments to determine their binding kinetics.

163. **Jiaxuan Ye**

Intertemporal Portfolio Optimization with Deterministic Consumption Plan under Taxation

Department: Applied Mathematics

Advisor: Gu Wang

Degree Level: Ph.D.

Keywords: Portfolio Choice, Stochastic Control, Deferred Tax, N/A, N/A

Description: We study an intertemporal portfolio optimization under taxation in a complete market. Managers are forced to invest their earnings back to the fund, and they can withdraw a deterministic portion of future discounted wealth to consume. We find the best strategy to maximize the expected utility under infinite horizon.

164. **Michael Yereniuk**

Chemical Absorption Modeling in Fluid Flow

Department: Applied Mathematics

Advisor: Sarah Olson

Degree Level: Ph.D.

Keywords: Agent-Based Models, Partial Differential Equations, Fluid Dynamics, Upscaling, Chemical Absorption

Description: The goal of this project is to develop a modeling framework to capture changing cell states of cells or organisms that are exposed to chemical stimuli when in a fluid flow. A discrete agent-based simulation of chemical absorption-led state changes motivates the derivation of the continuous partial differential equation model. We compare agent-based simulations with numerical solutions for different cases of fluid motion that bias movement and/or chemical profiles.