# Celebrating Graduate Research

## GRADUATE RESEARCH INNOVATION EXCHANGE (GRIE)

*Annual Graduate Research Celebration*

**February 9-15, 2022**

*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*

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

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WPI

**Welcome to the Graduate Research Innovation Exchange**

Thank you for participating in WPI's Graduate Research Innovation Exchange (GRIE) 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 view pre-recorded presentations, you will see more than 140 graduate researchers representing a diversity of disciplines. They have prepared 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. In their presentations, our students have discussed the important technological, scientific, and societal challenges they are tackling, detailed the methods they are using, explained the results of their work to date, and proposed the next steps in their journey of discovery.

As you prepare to watch presentations, here are a few things to keep in mind:

- Presentations have been pre-recorded. Students were asked to keep their video to 7 minutes to less.
- No awards will be presented following this week. Instead, judges will select finalists to present on April 5 during the GRIE Finals event.

We hope you can join us for the GRIE finals on April 5, and that you enjoy our graduate researchers presentations this week.

**Rory Flinn**
Assistant Dean of Graduate Studies

# Acknowledgements

## Special thanks to…

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

- Our hardworking student support team

- The following offices and their staff for their continued support and efforts in making this program run successfully:

  Marketing and Communications
  Events
  Academic Technology Center
  Network Operations
  Graduate Studies Academic Departments

- The GRIE Planning Committee:

  Terri Anne Camesano, Professor and Dean of Graduate Studies
  Bogdan Vernescu, Vice Provost for Research

- Faculty Committee Members:

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

**…and, especially, our Graduate Students!**

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

**1. Munevver Elif Asar Sarikaya**
**A Drying Model to Simulate Moist Porous Media with Excess Liquid Layers**
Department: Mechanical Engineering
Advisor: Jamal Yagoobi
Degree Level: Ph.D.
Keywords: excess water, drying, paper, energy consumption, reducing carbon emissions
Description: To reduce the carbon footprint and energy consumption of manufacturing sectors (i.e. paper manufacturing), novel drying mechanisms need to be studied because drying has a major contributor to the overall energy consumption of the manufacturing processes. Novel drying methods may require a fundamental understanding of drying of moist porous media with excess liquid layers. A new drying model has been developed that lifts some of the l limitations of the current drying models. The presented model enables simulating porous media with excess liquid layers.

**2. Alexander Castaneda**
**Numerical Investigation of Dielectrophoretic Force Enhanced Liquid Film Boiling**
Department: Mechanical Engineering
Advisor: Jamal Yagoobi
Degree Level: Ph.D.
Keywords: Electrohydrodynamics, Heat Transfer, Fluid Mechanics, Dielectrophoresis, Space Technology
Description: Liquid film flow boiling is considered impractical in the absence of gravity, due to the lack of a buoyancy force. Dielectrophoresis (DEP) is a phenomenon which takes advantage of a two-phase interface to introduce a force that can effectively remove vapor and enhance the heat transfer of liquid film flow boiling in the absence of gravity. This study involves numerical investigations into the effect of the DEP phenomenon on this enhancement.

**3. Yinduo Chen**
**Identification and Quantification of a Wide Variety of Inorganic Nanoparticles in Municipal Wastewater**
Department: Civil Engineering
Advisor: John Bergendahl
Degree Level: Ph.D.
Keywords: Dynamic light scattering, Environmental impact, Inductively coupled plasma, Nanoparticles, Scanning electron microscopy
Description: Increasing use of inorganic nanoparticles in consumer products and industrial processes has resulted in a more significant presence of these nanoparticles in wastewater, and it is essential to understand the occurrence and characteristics of this material in wastewater. The objectives of this research were to further develop and improve techniques to identify, quantify, and characterize these inorganic nanoparticles, and investigate their presence in wastewater from a large community with diverse wastewater sources.

**4. Nolan Dexter-Brown**
**Investigation into the Physics behind the Deflagration to Detonation Transition**
Department: Aerospace Engineering
Advisor: Jagannath Jayachandran
Degree Level: Ph.D.
Keywords: Combustion, Explosions, DDT
Description: This study aims to deepen our understanding of the controlling physics behind the phenomenon in which an initially subsonic flame (deflagration) abruptly transitions to a supersonic shock coupled reaction front (detonation). Understanding and predicting this transition is vital to preventing industrial disasters, designing highly efficient energy conversion devices, and elucidating supernova type Ia explosions.

**5. Kaoutar Diouri**
**Stress Response and Fragmentation Mechanism of Aged Asphalt Pavement during Milling**
Department: Civil Engineering
Advisor: Tahar El-Korchi
Degree Level: Ph.D.
Keywords: Asphalt Milling, Dynamic Fracture, Long-term Aging, Stress field, Crack Formation
Description: Milling is a necessary activity for the removal of aged pavements and the recovery of Reclaimed Asphalt Pavement (RAP) for recycling.
This study shows the potential of milling-induced stresses in the layers below the milling depth that can cause major failures and the life of the rehabilitated pavements is shortened. Furthermore, the dynamic fragmentation mechanism during milling is investigated to improve the RAP material quality and hence to a significant amount of conservation of natural resources during pavement construction.

**6. Armaghan Ehsani Telgerafchi**
**Finite Element Analysis Modeling of Gravity-Driven Multiple Effect Thermal System (G-METS) Distillation for Efficient Low-Cost Magnesium Refining**
Department: Mechanical Engineering
Advisor: Adam C. Powell
Degree Level: Ph.D.
Keywords: multiple effect distillation, finite element analysis, comsol, heat tansfer
Description: This presentation is developing a microscopic model for a novel continuous gravity-driven multiple effect thermal system (G-METS) approach for magnesium distillation. Modeling is presented as a design tool for determining the effect of geometric parameters such as feature size, and operating parameters such as temperatures, on separation performance and energy consumption of distillation. The present work used the COMSOL Finite Element Analysis software to analyze fluid flow, pressure distribution and heat and mass transfer in the system.

**7. Jihan El Ouaragli**
**Novel Smart Polymer-Sorbent Based Thermal Battery System**
Department: Civil Engineering
Advisor: Steven VanDessel
Degree Level: Ph.D.
Keywords: Thermal Energy Storage, Sorbent, Polymer, Heat & Mass transfer
Description: Created a battery system that is totally temperature dependent and able to passively store and release heat based on its surrounding temperatures. The battery can be integrated in textiles for thermal comfort and can also be used for frost protection applications.

**8. Xingtong Guo**
**How indoor environment quality affected college students' mental health and learning performance during COVID-19: A longitudinal study**
Department: Civil Engineering
Advisor: Shichao Liu
Degree Level: Ph.D.
Keywords: Stress, Depression, Learning performance, Logistic regression
Description: During COVID-19 pandemic, people's lifestyle have been changed dramatically and and increase of depression among young adults has been observed. Since people are spending most of their time at home during COVID-19, this study tried to understand how the indoor environment quality will affect students' mental health and learning performance.

**9. Rafael Gutierrez**
**Efficient RF Cathode Design for Electric Spacecraft Thrusters**
Department: Aerospace Engineering
Advisor: John Blandino
Degree Level: Ph.D.
Keywords: cathode, electric propulsion, radio-frequency
Description: This project involves the design of an efficient, radiofrequency (RF) electron source, or cathode for use in electric propulsion for spacecraft. The RF cathode generates electrons used to sustain the plasma discharge and provide charge neutralization. The RF cathode will also enable the use of condensable propellants, providing improved options for spacecraft and mission designers by allowing for more compact designs.

**10. Anass Harmal**
**Bioinpired Geopolymer Composites with Ultra-high Toughness**
Department: Civil Engineering
Advisor: Harold Walker
Degree Level: Ph.D.
Keywords: Geopolymer, Bioinspired, Toughness
Description: Geopolymer cement represents a promising alternative to Portland cement. Despite its environmental advantage, the brittleness of geopolymer limits its applications. In this study, bioinspired toughening mechanisms found in brick-and-mortar structured mineralized biological materials are explored. Experimental results reveal that strong and tough geopolymer-based composites can be achieved through a bioinspired brick-and-mortar structure. The geopolymer based composites showed up to a 700 times improvement in toughness, while retaining similar strength.

**11. Colin Hiscox**
**Holographic Vibrography for Non-invasive Measurement of Cell Tissues**
Department: Mechanical Engineering
Advisor: Cosme Furlong
Degree Level: Master's
Keywords: Digital Holography, Quality Control, Tissue Engineering, Vibration Measurements, Machine Learning
Description: This research explores the use of advanced optical metrology, including digital holography, to characterize fundamental physical properties of engineered biological tissues that are being used to restore healthy living tissues. Acoustic waves are used to induce vibrations in tissue samples while holographic imaging measures corresponding physical movements of the vibrations at key modes, allowing for non-invasive characterization of the samples. This approach has the potential application for in-line quality control or as a predictive qualifier for future growth patterns to streamline the large-scale manufacturing of artificial tissues.

**12. Hamed Jafarishad**
**Optical fiber strain sensor for food deformation measurements during drying**
Department: Mechanical Engineering
Advisor: Yuxiang Liu
Degree Level: Ph.D.
Keywords: Strain sensor, Optical fiber, Food deformation, Drying
Description: Foods shrink as they go through the drying process. In this work, an optical fiber strain sensor was developed to measure the shrinkage of foods both on and below the surfaces in real time during drying, which are not available now. The measurements of foods deformation can help to understand the food deformation in drying processes, to improve industrial drying process control, and to enhance the food quality.

**13. Sarah Jordan**
**Additive Manufacturing Evaporative Casting (AMEC) Capabilities and Benefits**
Department: Manufacturing Engineering
Advisor: Chris Brown
Degree Level: Ph.D.
Keywords: additive, manufacturing, casting, 3D printing
Description: A novel hybrid additive manufacturing process is being developed that combines 3D printing with lost foam investment casting. The new process called AMEC (additive manufacturing evaporative casting) combines the benefits and eliminates the drawbacks of both casting and additive manufacturing. Preliminary findings on the process capabilities and microstructure will be reviewed.

**14. Oussama Khouchani**
**Effect of Cellulose Nanocrystals on Chemical Bonding and Gel Phases of Metakaolin-based Geopolymer Nanocomposites**
Department: Civil Engineering
Advisor: Harold Walker
Degree Level: Ph.D.
Keywords: Metakaoilin, Geopolymer, Nanocellulose, Nanocomposites
Description: The purpose of this research is to study the influence of adding cellulose nanocrystals (CNC) on the reaction kinetics of metakaolin-based geopolymer.

**15. Andrei Koch**
**Experimental Design for Direct Diagnostics of Flashover Propagation Velocity**
Department: Aerospace Engineering
Advisor: Nikolaos Gatsonis
Degree Level: Ph.D.
Keywords: Spacecraft, Charging, Plasma, Flashover, Diagnostics
Description: Flashover discharges plasmas pose an environmental risk to the function of spacecraft by extending the arc power that damage spacecraft electronics. The propagation velocity of flashover plasmas is one of the more poorly understood quantities that govern the coupling of the flashover discharge plasma to the extension of the arc power. This research lays out the work being pursued by WPI's Aerospace Engineering department to experimentally simulate, and directly measure the propagation velocity components of these events utilizing novel current collection methods.

**16. Meenakshi Kodali**
**A methodology to determine crystal/binder interface adhesion in polymer-bonded explosives**
Department: Aerospace Engineering
Advisor: Nikhil Karanjgaokar
Degree Level: Master's
Keywords: Polymer-bonded explosives, Interface debonding, Peel testing, Tensile testing, Analytical modeling
Description: Polymer-bonded explosives are composite materials consisting of explosives crystals embedded in a polymer binder. Accidental detonation of these materials can occur due to hot spot formation at the crystal/binder interface. This work develops a methodology to study crystal/binder interface adhesion in an effort to reduce the chances of accidental detonation.

**17. Theresa Larson**
**Aerospace Structural Health Monitoring for Polymer Bonded Explosives**
Department: Aerospace Engineering
Advisor: Nikhil Karanjgaokar
Degree Level: Master's
Keywords: Aerospace, Damage Propagation, Explosives, Computational Modeling,
Description: The first step of this research was to look at the codependent structural and thermal behavior of a beam when reacting to an applied force. The second step that is ongoing is to create a model of this behavior that correlates to the behavior of polymer bonded explosives. This model will make it possible for tracking of flaws in the explosives that may lead to premature ignition, creating a safer environment when working with or transporting the explosives.

**19. Joel Mathew**
**Drop Tower Design and g-force Reduction Methodology for Hydrofluorocarbon Combustion Experiment**
Department: Aerospace Engineering
Advisor: Jagannath Jayachandran
Degree Level: Ph.D.
Keywords: Combustion, Hydrofluorocarbons, Laminar flame speed, Drop Tower, g-force reduction
Description: Refrigerants that are currently in use are being phased out and replaced by environmentally friendlier hydrofluorocarbons (HFCs), which are flammable and pose fire risks. Quantifying their reactivity is challenging as their flames are strongly affected by buoyancy-induced flows. This project details the design and testing of a drop tower to circumvent this difficulty and measure flame propagation rates accurately.

**20. Zahra Noori**
**Experimental Study of Drying of Paper with Ultrasound Mechanism**
Department: Mechanical Engineering
Advisor: Jamal Yagoobi
Degree Level: Ph.D.
Keywords: Ultrasound, Drying, Porous Media, Energy Saving
Description: In a power-hungry industry such as paper-making, the main challenge is to improve the energy efficiency of the process. In this research, for the first time, a systematic study is done using an innovative technology for paper drying by applying ultrasound mechanism. The advantages of ultrasound drying include greater energy efficiency, lower time and temperature of drying, improvement of the product quality, and it is considered a green technology.

**21. Nathaniel O'Connor**
**Thermal Modeling of EHD Experiment Payload for Sub-orbital Rocket Flight**
Department: Mechanical Engineering
Advisor: Jamal Yagoobi
Degree Level: Ph.D.
Keywords: Electrohydrodynamics, Heat Transfer, Numerical, CFD
Description: Electrohydrodynamics (EHD) involve the interaction between fluids and electric fields, which offer significant enhancements to heat transfer, especially in a microgravity environment. Prior to sending an experiment to the International Space Station, the EHD team will perform testing on a sub-orbital rocket flight allowing for a longer microgravity duration compared to previous parabolic flight experiments. This work details the thermal analysis required for both safety and science for the EHD sub-orbital rocket flight payload to be flown later in 2022.

**22. Abhinandan Singh**
**Influence of unsteady near-bed flame behavior on fire spread through pine needle bed**
Department: Fire Protection Engineering
Advisor: Albert Simeoni
Degree Level: Ph.D.
Keywords: Wildland fires, Fire spread, Heat transfer, Flame pulsations
Description: The non-continuous flame propagation through pine needle beds is explored by conducting fire experiments in a laboratory-scale wind tunnel. Most of the previous research considers fire propagation a pseudo-steady process, while flame pulsations lead to intermittent ignitions and extinctions ahead of the fire front. These pulsations are observed and evaluated using cameras around the fuel bed, while the temperature is measured through the bed to acquire the flame interface.

**23. Justin Tavares**
**Flame Propagation and Radiation Aspects of Hydrofluorocarbon Flames**
Department: Aerospace Engineering
Advisor: Jagannath Jayachandran
Degree Level: Ph.D.
Keywords: Combustion, Hydrofluorocarbons, Optically-thin radiation, Laminar flame speed, Spherically expanding flames
Description: Halogenated hydrocarbons are extensively used as refrigerants and fire suppressants. Compounds that are currently used by the industry have large global warming potential and/or ozone depletion potential. Environmentally friendlier alternatives that have been identified are hydrofluorocarbons (HFC), which are flammable and pose fire risks. This study investigates important flammability characteristics for HFC compounds, specifically the effect of radiation heat loss, and explores potential solutions to challenges associated with experimental characterization.

**24. Mobin Vandadi**
**Oxide Effect on the Cold Spray Process of Al-6061**
Department: Civil Engineering (MEng)
Advisor: Nima Rahbar
Degree Level: Ph.D.
Keywords: Cold Spray, Finite Element Simulation, Bonding
Description: Cold spray is a recent and growing method for repairing or making material. However, any impurities like oxide in the system would influence the strength of the final material. In this work, the effect of oxide on the strength of the cold sprayed material is investigated.

**25. Shuai Wang**
**A Self-Healing Enzymatic Construction Material**
Department: Civil Engineering
Advisor: nima rahbar
Degree Level: Ph.D.
Keywords: carbonic anhydrase, self healing, crystal growth
Description: We develop a negative emission self healing construction material.

**26. Chao Wang**
**Effects of CO2 and bio-effluents on driving performance**
Department: Civil Engineering
Advisor: Shichao Liu
Degree Level: Ph.D.
Keywords: Indoor air quality, CO2 concentration, Body odor, Driving performance, Cognition task
Description: we have investigated drivers' cognitive performance related to driving in a simulator controlled at various CO2 and bio-effluents levels. The research can benefit the ventilation design of vehicles to improve driving performance and air quality satisfaction.

**27. Zhiying Xiao**
**A novel SS-PCM system for building enclosures**
Department: Civil Engineering
Advisor: tao mingjiang
Degree Level: Ph.D.
Keywords: phase change material, building energy, thermal storage
Description: our research focus on passively mitigating energy consumption on buildings by novel material, such as optical SS-PCM film, which was firstly synthesis by our group.

**28. Mengxuan Zhao**
**Effect of Filling Solutions on Chemical Volume Change of Metakaolin-based Geopolymers**
Department: Civil Engineering
Advisor: Mingjiang Tao
Degree Level: Ph.D.
Keywords: Geopolymer, Chemical volume change, Metakaolin, ICC, FTIR
Description: Geopolymer, a family of inorganic aluminosilicate materials, is a promising alternative to ordinary Portland cement (OPC) because of its comparable mechanical properties to OPC, such as excellent fire resistance and low CO2 emission during the production. However, geopolymers are not widely applied in civil engineering mainly because of the lack of guaranteed long-term performance. Shrinkage and the resulting cracking are critical reasons causing the deterioration of volume stability of constructions, especially the chemical volume change. Large chemical volume change will result in early-age cracking, and further cause larger autogenous and drying shrinkages. Early cracks will also result in the deterioration of the construction components, such as the fall of protective layer, corrosion of internal steel, and long-term carrying capacity of structure, then further affect their durability and service life. Furthermore, the existing testing procedure of OPC is not applicable to geopolymers since the different hydration processes. Therefore, understanding the mechanism under chemical volume change and developing a testing standard for geopolymer become extremely important.

**29. Luqing Zhu**
**Cooperative Spot Ignition by Idealized Firebrands: Impactof Fuel Bed Thermal Interaction**
Department: Fire Protection Engineering
Advisor: James Urban
Degree Level: Ph.D.
Keywords: Firebrand Spotting, Wildland-Urban Interface Firebrand, Thermal interaction
Description: Firebrand spotting is believed to be a major cause for structure losses in wildland-urban interface (WUI) fires in California. It has been well established that accumulation of firebrands is capable of igniting components of structures such as wooden decks or siding of houses that would not be susceptible to single firebrands, but it is not clear what conditions the firebrands act as an accumulation rather than individual firebrands. The goal of this work is to understand how closely firebrands must be grouped in order to cooperatively ignite the fuel through experimental study as well as two-dimensional numerical simulations of a wooden fuel element receiving heat from firebrands. The results could also help devise engineering solutions to firebrand attack and enable future study of the other types of interactions between firebrands.

**30. Jonathan Zimak**
**Effect of Inert Gas Discharge Time on Wooden Class a Fire Test Performance and Extinguishment**
Department: Fire Protection Engineering
Advisor: Albert Simeoni
Degree Level: Master's
Keywords: Inert Gas, Class A Fire Tests, Scaling, Wood Cribs
Description: Recent changes to fire codes have changed the amount of time gas-based fire suppression systems discharge, and therefore how they are tested. These changes were studied in a reduced and full-scale test environment to identify any potential safety concerns.

## *Business and Social Science*

**31. Sahar Ebrahimi Bajgani**
**a reverse supply chain network of ventilators**
Department: Business Administration
Advisor: Sara Saberi
Degree Level: Ph.D.
Keywords: Reverse Supply Chain, Game Theory, Ventilators, Subsidy
Description: Motivated by ventilator shortage during Covid19 pandemic, we designed a reverse supply chain network of ventilators with collective centers, 3rd party remanufacturers, and recyclers. Collective centers collect qualified returned ventilators and damaged ventilators and send them to remanufacturers and recyclers. The equilibrium condition is governed using a variational inequality model.

**32. Luis Kleinknecht**
**Family Business Internationalization and International Exposure: An emerging market's point of view**
Department: Business Administration
Advisor: Frank Hoy
Degree Level: Ph.D.
Keywords: International Entrepreneurship, Corporate Entrepreneurship, Family Business, Intergenerational Entrepreneurship, International Business
Description: The internationalization of family firms is an important entrepreneurial strategy for growth and long-term survival (Alayo et al., 2020). International experiences of managers can bring a fresh perspective to the business, broadening its strategic planning. This research explores the impact of international exposure on whether to internationalize or not the family business.

**33. Vy Ngo**
**The Effects of Superfluous Brackets on Solution Processes and Performance during Math Problem-Solving**
Department: Learning Sciences & Technologies
Advisor: Erin Ottmar
Degree Level: Master's
Keywords: basic arithmetic, mathematics education, perceptual learning, eye tracking
Description: Prior research has shown that how math problems are visually presented affect the way we reason and act on the math notation. However, there are not many studies using eye-tracking technology to further examine how different presentations of math problems impact our attention, cognitive processing, and performance during problem-solving. This study explores how different presentations of math problems affect individualsâ€™ eye movement and math performance.

**34. Luisa Perez**
**Themes in Student Justifications in Computational Thinking**
Department: Learning Sciences & Technologies
Advisor: Erin Ottmar
Degree Level: Master's
Keywords: Computational Thinking, Vignettes, Qualitative Coding
Description: We deployed a study in the Spring of 2020 collecting student responses on deciding whether or not certain vignettes were classified as computational thinking. We are compiling student answers and are looking to tease out themes that emerge from the qualitative code.

**35. Hannah Smith**
**The Spatial Superpower: How Mental Rotation Skills Relate to Geometry Performance**
Department: Learning Sciences & Technologies
Advisor: Erin Ottmar
Degree Level: Ph.D.
Keywords: Mental Rotation, Geometry, Learning
Description: This study examined the relation between mental rotation skills and geometry performance among middle school students in an online homework platform. We found that higher mental rotation skills are related to higher geometry performance above and beyond the structure of the problem and the strategies used.

**36. Lidan Zhang**
**Evaluating the impact of media richness on a medical proxy decision aid tool using eye-tracking**
Department: Information Technology
Advisor: Lidan Zhang
Degree Level: Ph.D.
Keywords: User experience, Decision aid, Media richness, Eye tracking, User engagement
Description: Making a life-or-death decision for a loved one could be extremely difficult. Decision aid (DA) could help decision-makers make a more informed decision. It is crucial to design the DA to communicate information effectively and engage with users in such an emotional and cognitively complex situation. Given that enriching media in the DA could potentially facilitate user experience, in this study, we examined if media richness affects user engagement, social presence, decision quality, and user satisfaction of the DA.

## *Chemical Engineering and Materials Science*

**37. Elizabeth Belden**
**Utilizing predictive machine learning models for thermodynamic optimization of river plastic conversion**
Department: Chemical Engineering
Advisor: Michael Timko
Degree Level: Ph.D.
Keywords: Waste Plastic, Machine Learning, Hydrothermal Liquefaction, Thermodynamics
Description: Millions of tons of plastic are produced annually and due to mismanagement of waste much of it ends up in the environment. Converting this environmental plastic, especially that found in rivers, into fuels via thermal processes is a promising way to handle the waste. This work looks at utilizing predictive machine learning models to be able to predict reaction oil yields given real waste plastic compositions found in rivers around the world.

**38. Chinenye Chinwego**
**Techno-Economic Analysis of Rare Earth Metal Recycling Using Efficient Metal Distillation**
Department: Materials Science & Engineering
Advisor: Adam Powell
Degree Level: Ph.D.
Keywords: Recycling, Distillation, Rare Earths, Techno-Economic Analysis
Description: Recycling has been proposed as a promising potential source of supply to meet some of the U.S. rare earth demand for use in permanent magnets. The high growth rates of products that make use of rare earth magnets--particularly wind turbines and electric and hybrid vehicles--show that their stock in use is on the rise and in the near term will become available as scrap feed for recycling. This study presents an overview of magnet recycling technologies and focuses on the techno-economic analysis of liquid metal leaching and distillation, including the effect of a new continuous gravity-driven multiple effect thermal system (G-METS) metal distillation technology on energy use and overall cost.

**39. Fatou Diop**
**Continuous Liquid-Liquid Extraction of Salicylic Acid with Integrated Membrane Separation**
Department: Chemical Engineering
Advisor: Andrew Teixeira
Degree Level: Ph.D.
Keywords: Continuous flow, Extraction, Mixing, Pharmaceuticals
Description: Extraction is a process describing the transfer of a chemical from one solvent to another. In this work, we have carried out the extraction of salicylic acid in a batch system and a continuous system. The continuous flow system performed better and could be easily optimized by adding a static mixer to reach complete extraction in minutes.

**40. Lily Gaudreau**
**Revealing cellular structural properties at the host-pathogen interface during Staphylococcus epidermidis biofilm infections**
Department: Chemical Engineering
Advisor: Elizabeth Stewart
Degree Level: Ph.D.
Keywords: Bacterial Biofilms, Staphylococci, Microfluidics, Infection Model, in vitro
Description: Approximately 500,000 people die from, or with, biofilm infections every year. These fatal infections predominantly form on surfaces of medical devices, such as central venous catheters, which means the biofilm develops at the host-pathogen interface. In this study, we aim to recapitulate the host-biofilm interface in an experimental model system that includes the co-culture of staphylococcal biofilms and tissue cells. The cultures are grown under conditions similar to those within a patient, and we investigate structural properties of each cell type in this complex growth environment.

**41. Walter Gerych**
**Recurrent Bayesian Classifier Chains for Multi-Label Classification**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: machine learning, deep learning, probabilistic models, graphical models, multi-label learning
Description: In this work, we incorporate Bayesian networks into state-of-the-art multi-label classification methods to directly model class interdependencies. We show the validity of this approach both analytically and empirically, and significantly outperform the state-of-the-art on a variety of benchmark datasets.

**42. Jack Grubbs**
**Polymer 3D Printing Process Parameter Optimization for Enhanced Performance**
Department: Materials Science & Engineering
Advisor: Danielle Cote
Degree Level: Ph.D.
Keywords: 3D Printing, Polymers, Characterization, Additive Manufacturing
Description: Polymer 3D printing (3DP) is an accessible and high-throughput manufacturing technique widely available to consumers. However, the 3DP community is currently lacking scientific studies that systematically investigate the effects of printer parameters on resultant component properties and performance. The present work explores the effect of processing parameters on the dimensional accuracy, mechanical properties, and thermal characteristics of 3D-printed PLA, providing an experimental guide for all 3DP users to obtain consistently successful prints with optimal performance.

**43. Wenxu Han**
**A New Antimicrobial Peptide-Antibiotic Combination Strategy for P. aeruginosa Inactivation**
Department: Chemical Engineering
Advisor: Terri Camesano
Degree Level: Ph.D.
Keywords: Antimicrobial Peptide, Combination Strategy, Synergistic Effects
Description: Pseudomonas aeruginosa (P. aeruginosa) is an opportunistic pathogen which causes severe infections towards different tissues in human body, but currently traditional antibiotic treatments are hard to cure these infections because the lower outer membrane permeability of P. aeruginosa limits the uptake of antibiotics. To deal with the issue, a novel potential treatment strategy has been developed in our lab by combining antimicrobial peptide LL-37 with different antibiotics to combat P. aeruginosa strains in vitro.

**44. Reisya Ichwani**
**Interfacial Fracture in Perovskite Solar Cells**
Department: Materials Science & Engineering
Advisor: Winston Soboyejo
Degree Level: Ph.D.
Keywords: Perovskite solar cells, Processing, Toughness
Description: Perovskite solar cells (PSCs) have gone through a familiar research and development trajectory such as improving performance and stability, upscaling, and enhancing mechanical reliability before commercialization. In this study, we explore the effects of processing on interfacial robustness of PSCs and correlate it to the performances of the solar devices.

**45. David Kenney**
**Revolutionizing waste management with greenhouse gas infrastructure with negative emission technologies**
Department: Chemical Engineering
Advisor: Andrew Teixeira
Degree Level: Ph.D.
Keywords: Carbon Capture, Circular Economy, Life Cycle Assesment
Description: Today, the United States produces 290 million tons of municipal solid waste each year. The treatment of this waste contributes 250 million tons of CO2eq of GHG each year. This poster will aim to compare different waste management technologies to define the impact of carbon capture and sequestration

**46. Alexander McMahon**
**Cathode-Electrolyte Structures Direct Carbon Fuel Cell**
Department: Materials Science & Engineering
Advisor: Adam Powell
Degree Level: Master's
Keywords: Energy, Fuel Cell, Sustainability, Ceramic, Slip Cast
Description: Previous work has ideated a high-efficiency direct carbon fuel cell and developed its liquid metal anode. The formulation and fabrication process for the cathode-electrolyte structure, a 3-layer ceramic composite designed to be submersed in the molten anode, is developed in this work. Performance of the novel cell is presented.

**47. Patryck Michalik**
**Elucidating how biofilms self-regulate their properties by characterizing local pH and mechanics**
Department: Chemical Engineering
Advisor: Elizabeth Stewart
Degree Level: Ph.D.
Keywords: biofilms, microrheology, quantitative image analysis
Description: Staphylococcus epidermidis biofilms are communities of bacterial cells encased within a protective matrix which frequently cause hospital related and medical device associated infections. Here we assess the relationship between local pH and mechanical properties in S. epidermidis biofilms to mechanistically understand how biofilms self-regulate their properties. This study will inform the development of novel biofilm prevention and treatment methods guided by our understanding of how biofilms control their mechanical properties and microenvironments.

**48. Aditya Moudgal**
**Macroscopic and Phase Field Modeling of Silicon by Molten Salt Electrolysis**
Department: Materials Science & Engineering
Advisor: Adam Powell
Degree Level: Ph.D.
Keywords: Electrometallurgy, Computational Materials Science, Finite Element Method, Phase Field Method
Description: Conventional production of solar silicon by the Siemens Process is energy intensive, has inherent safety challenges and is expensive due to multiple operations. This presentation looks at production of silicon through an environmentally friendly, electrometallurgical route at a much cheaper price. It discusses the characteristics required in an electrochemical cell to produce solar grade silicon.

**49. Sydney Packard**
**Uncovering how bacterial infections spread by characterizing cells dispersed from biofilms**
Department: Chemical Engineering
Advisor: Elizabeth Stewart
Degree Level: Ph.D.
Keywords: bacterial biofilms, Staphylococci, biocolloids, biopolymers
Description: The dispersion of surface-attached bacteria – known as biofilms – from medical devices enables the spread of infection to additional sites of the body, particularly if the bacteria is released in high concentrations or the released cell clusters are above the size threshold for host immune system clearance. My current research focuses on determining the cellular concentration and size distribution of cell clusters released from S. epidermidis biofilms using an image analysis method in Python. Through quantitative analysis of biofilm-released cells, my goal is to determine how different treatment methods influence dispersion in order to guide the development of biofilm infection treatment strategies that both disrupt biofilms and prevent the spread of infection.

**50. Qian Qian**
**DFT Study on CO2 Reduction on Carbon Doped Co/g-C3N4**
Department: Chemical Engineering
Advisor: Aaron Deskins
Degree Level: Ph.D.
Keywords: C3N4, DFT, CO2 Reduction
Description: Catalyst search for CO2 reduction is crucial for 21st century. Among all possible photocatalysts, g-C3N4 stands out for its versatile modifications with different metal atom and doping possibilities. This project is focused on the CO2 reduction potential of Carbon Doped Co/g-C3N4.

**51. Mahya Shahabi**
**Emission-free Mg-air battery**
Department: Materials Science & Engineering
Advisor: Adam C. Powell
Degree Level: Ph.D.
Keywords: Emission-free, Metal-air battery, Magnesium, Alternative energy source, Battery design
Description: Our designed Mg-air battery for transpacific zero-emission cruising can provide 90-120 MWh energy. This compares with just 3 MWh from Tesla Megapack which is the highest-capacity containerized lithium-ion battery. Experimental results show 1.9V open-circuit voltage, which is the highest to date for an Mg-air battery. Our experimental results show 1.9V open-circuit voltage, which is the highest to date for an Mg-air battery.

**52. Bryer Sousa**
**Accelerating Metallic Materials Design via Rapid Indentation Testing Methods**
Department: Materials Science & Engineering
Advisor: Danielle Cote
Degree Level: Ph.D.
Keywords: Plasticity, Indentation, Mechanics, Metallurgy, Materials Design
Description: As the need for novel materials design continues to evolve in the modern era, materials engineers must also consider the need for novel and rapid means of evaluating promising materials. The need for new and quick materials property evaluation methods can be appreciated when considering the financial burden of manufacturing enough material for traditional mechanical property evaluation and that new materials still take at least 10 to 20 years of R&D for a given application. Accordingly, we introduce two indentation-based approaches to measuring metallic material strengths: indentation plastometry and flat-punch nanoindentation.

**53. Himanshu Tanvar**
**Comprehensive recycling of bauxite residue**
Department: Material Science and Engineering
Advisor: Brajendra Mishra
Degree Level: PhD
Keywords: Recycling, Sustainability, Bauxite residue, Hydrometallurgy, Urban mining
Description: Bauxite residue is a toxic industrial waste generated during the production of aluminum metal. The global annual production of bauxite residue is more than 150 million tons with near zero recycling rate. The following research deals with comprehensive recycling of bauxite residue for extraction of critical raw material for industrial application and contributes towards urban mining and sustainability.

**54. Ziqi Wei**
**Characterization of LL37 Binding to Collagen through Collagen-Binding Domains (CBDs)**
Department: Chemical Engineering
Advisor: Terri Camesano
Degree Level: Ph.D.
Keywords: Biomaterials, Antimicrobial peptide, Collagen
Description: This study investigates an antimicrobial peptide-loaded collagen chronic wound dressing. This study characterizes and quantifies the binding between antimicrobial peptides and collagen. Results will develop a characterization and quantification methodology for antimicrobial peptides and collagen binding.

**55. Yi Jie Wu**
**Potential use of Magnesium Hydride Slurry as an Sustainable Aerospace Fuel**
Department: Chemical Engineering (Professional MS)
Advisor: Jagan Jayachandran
Degree Level: Master's
Keywords: Fuel, Combustion, Sustainability, Metal, Aerospace
Description: The purpose of this project is to investigate the potential of using a magnesium hydride-hydrocarbon slurry as an alternative and sustainable aerospace fuel. This presentation will display thermodynamic and range comparisons between the slurry and a surrogate fuel (n-Dodecane) as well as video imagery of fuel droplet combustion experiments performed.

## *Data Science, Cybersecurity, Computer Science, and Interactive Media*

**56. Noura Alghamdi**
**Scalable Time Series Compound Infrastructure**
Department: Computer Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: intermittent yet interrelated time series, long gaps, misalignment-resilient representation, similarity-match semantics, distributed systems
Description: Objects ranging from a patient's history of medical tests to an IoT device's series of sensor maintenance records leave digital traces in the form of big time series. These time series objects do not only span exceedingly long time periods (sometimes years), but are also characterized by intermittent yet interrelated time series measurements punctuated by long gaps of silence. This prevalent data type, which we refer to as Time Series Compound (TSC) objects, has been largely overlooked in the literature. We introduce new similarity-match semantics as well as a compact misalignment-resilient representation for TSC. Upon this foundation, we then design a TSC-aware distributed indexing infrastructure that supports scalable storage, indexing and querying of TB-scale TSC datasets.

**57. Khulood Alkhudaidi**
**Towards Sign Language Centric Design**
Department: Computer Science
Advisor: Erin Solovey
Degree Level: Ph.D.
Keywords: American Sign Language, Accessibility, User Centered Design, STEM Education, Questionnaires
Description: The project explores the potential of developing sign language based technology where fluency in a written language is not required. Since sign language has no writing format, sign language technology requires the development of sign language based user interface components such as layout and menus. To better facilitate fundamental research data collection from deaf and hard of hearing individuals, we are working toward creating survey tools that meet the needs of deaf individuals using sign languages without obligatory reliance on a written language to complete a questionnaire

**58. Abdulsalam Almadani**
**Cardiac Assessments using Video-Based Neural networks Models on Echocardiograms**
Department: Data Science
Advisor: Emmanuel Agu
Degree Level: Ph.D.
Keywords: Computer Vision, Echocardiograms, Video Classification, cardiac assessment, Artificial intelligence
Description: Echocardiography captures videos that can be used to examine how blood is pumped via the heart's chambers and valves to detect cardiac conditions such as Heart failure. Our research systematically explores state-of-the-art using Video-based neural networks for echocardiogram analyses.

**59. Wafaa Almuhammadi**
**OAPain-sense: a Machine Learning Approach to Predict Pain from GaitParameters Using IMU in Knee and Hip Osteoarthritis**
Department: Computer Science
Advisor: Emmanuel Agu
Degree Level: Ph.D.
Keywords: Gait, Osteoarthritis, Pain Assessment, Machine Learning, Spatio-temporal gait parameters
Description: This study investigates the relationship between the Hip or Knee Osteoarthritis (OA) pain level and gait and movement patterns that can serve as reliable biomarkers. Such biomarkers may be use to infer disease symptoms of at-risk OA populations in natural settings.

**60. Luke Buquicchio**
**Few-Shot Classification for Human Context Recognition Using Smartphone Data**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: Few Shot, Semi-supervised learning, human context recognition, smartphone sensor data,
Description: In this work we study how to train machine learning classifiers to recognize human behavior leveraging limited amounts of labeled data. This is a relatively well-studied problem within the computer vision domain, but remains largely unexplored for Human Context Recognition (HCR). We explore the performance of state-of-the-art methods in a comprehensive set of experiments in the HCR domain.

**61. Kathleen Cachel**
**MANI-RANK: Multiple Attribute and Intersectional Group Fairness for Consensus Ranking**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: Algorithmic Fairness, Consensus Ranking, Group Fairness
Description: Combining the preferences of many rankers into one single consensus ranking is critical for consequential applications from hiring and admissions to lending. This work addresses the open multi-attribute consensus ranking problem. First designing a comprehensive group fairness notion for multi-value and multiple protected attributes. Then designing a series of algorithms to solve the multi-attribute consensus ranking problem.

**62. Geri Dimas**
**Modeling the United States Immigration Court System: Using simulation and Data Science to effectively deploy capacity**
Department: Data Science
Advisor: Andrew Trapp
Degree Level: Ph.D.
Keywords: Immigration, Discrete Event Simulation, Machine Learning, Social Good
Description: We explore modeling the intricacies of the United States immigration court system, reconstructing its various elements and their respective complexity through discrete event simulation and machine learning. We study possible improvements to the simulated system affecting capacities, such as the number of judges, queueing discipline, and alternative ways to distribute available capacity.

**63. Apiwat Ditthapron**
**ADL-GAN: Data Augmentation to Improve In-the-wild ADL Recognition using GANs**
Department: Computer Science
Advisor: Emmanuel Agu
Degree Level: Ph.D.
Keywords: activity of daily living, imbalanced class, GAN, data augmentation, smartphones
Description: A person's patterns of Activities of Daily Living (ADLs) can provide insights into their physical and mental health, making ADL recognition from smartphone and smartwatch sensor data an important task. However, as people perform various ADLs unequally in real life, in-the-wild ADL datasets can be extremely imbalanced. To mitigate the imbalanced problem, we propose ADL-GAN, three data augmentation methods that utilize Generative Adversarial Networks (GANs) to generate synthetic smartphone sensor data for augmenting ADL classes with insufficient data.

**64. Ramesh Doddaiah**
**Learning Distinct Class-specific Saliency Maps for Deep Time Series Classifiers**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: Time Series, XAI, Explainable IA, Multiclass, Saliency Maps
Description: Generating post-hoc explanations by attribution-based methods are a common approach [1, 2] to highlight the most pertinent areas of the input features per class in deep learning model classifications. These attribution-based methods are ubiquitous in Images and Lan guage domains and their applications to time series are relatively new and specifically obtaining distinct class-specific saliency map has not been done to explain deep multiclass time series classifiers. In this work, we study this problem and propose MUX, a novel perturbation-based explainability method to learn distinct class-specific saliency maps to explain deep multiclass time series classifiers' decisions on time series which improves the method proposed by Prathyush et al. significantly. Specifically, our method jointly learns saliency maps of each class and removes the saliency maps of the other classes from the saliency maps of the target class to distinctively differentiate target features from other features.

**65. Vincent Filardi**
**Traffic Simulation and Prediction**
Department: Data Science
Advisor: Oren Mangoubi
Degree Level: Ph.D.
Keywords: Meta Learning, Automata, Network
Description: We use simulated vehicle traffic and Meta-Learning to assess the importance of the underlying road network on traffic prediction.

**66. Ricardo Flores**
**Depression Screening Using Deep Learning on Followup Questions in Clinical Interviews**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: depression, audio classification, transfer learning, virtual screening, mental health
Description: - Implementing a methodology to extract followup questions and answers from clinical interviews
- Leveraging state-of-the-art deep learning models to classify audio recordings
- Measuring the marginal effect of follow-up prompts for different core interview questions

**67. Wen Ge**
**QCRUFT: Quaternion Context Recognition under Uncertainty using Fusion and Temporal Learning**
Department: Computer Science
Advisor: Emmanuel Agu
Degree Level: Ph.D.
Keywords: Human Context Recognition, Ubiquitous Computing, Deep Learning
Description: Human Context Recognition (HCR) is a challenging multi-label classification task as smartphone sensor values for various contexts (defined as <Activity, Phone Placement>) vary across phone models, and how the user places the phone (proprioception). While realistic, HCR data collected in-the-wild frequently have missing or wrong user-provided context labels or timestamps. We propose Quaternion Context Recognition under Uncertainty using Fusion and Temporal Learning (QCRUFT), an end-to-end deep learning HCR framework that integrates several mechanisms for mitigating multiple challenges in in-the-wild HCR data including sensor signal variability, extreme data imbalance, and noisy context labels. In rigorous evaluation, QCRUFT achieved 76.4%and 70.6% in overall Balanced Accuracy (BA) on two real-world in-the-wild HCR datasets.

**68. Ashish Gurung**
**Exploring what matters when teachers grade Open Response problems**
Department: Computer Science
Advisor: Neil Heffernan
Degree Level: Ph.D.
Keywords: User Behavior, Computer based learning platforms, HCI
Description: In this work, we analyzed teacher behavior while grading 'Open Response' problems in a computer-based learning platform. We analyze teachers' scoring patterns when students' are anonymized vs. non-anonymized how it can influence teachers' grading habits.

**69. Aaron Haim**
**Promoting Experimental Research Design in Online Learning Platforms**
Department: Computer Science
Advisor: Neil Heffernan
Degree Level: Ph.D.
Keywords: Software Engineering, Online Learning, Experimentation
Description: The goal of this work is to provide future researchers with simple tools and architecture to conduct experiments within the ASSISTments platform. An experimenter can investigate different pedagogies by adjusting and creating components within the platform.

**70. Kevin Hickey**
**Improving The Training of Generative Adversarial Networks**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: Deep Learning, GAN, One Class
Description: We design a new method for effective training of Generative Adversarial Networks, also known as GANs. Specifically, we use a one-class classifier model to help guide the GAN training process to ensure theoretical assumptions are met, which leads to more stable training and improved generative performance.

**71. Dennis Hofmann**
**AutoOD: Automatic Outlier Detection Demo**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: automatic outlier detection, unsupervised outlier detection, interface demo
Description: Finding abnormal data within a dataset is an important data science task as outliers/ anomalies often signify errors across various domains. AutoOD is an unsupervised automatic outlier detection system which can be utilized by domain experts lacking a data science background to find anomalies in their data. I will be giving a brief overview of the system along with demoing the easy-to-use interface that provides insights on how AutoOD functions.

**72. Trusting Inekwe**
**Identity, Attitude, and Engagement of adult African American quilters towards computing**
Department: Computer Science
Advisor: Gillian Smith
Degree Level: Ph.D.
Keywords: Computational thinking, Computer Science, quilting, African American, underrepresentation
Description: Recruitment for this study will initially be from members of the Sisters in Stitches Joined by the Cloth (SISJBTC) quilt guild whose focus is on the African American perspective of quilting

**73. Nicholas Josselyn**
**An Empirical Evaluation of State-of-Art Deep Domain Adaptation Models**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: Domain Adaptation, Small data, Comparative study, Computer Vision
Description: Deep domain adaptation, a sub-category of transfer learning with the goal of adapting deep learning models from one or more domains (source) to a different domain (target), has been touted as a promising approach for dealing with limited data in a target domain of interest, and a rich slew of alternate methods have been proposed over the last 8+ years. In this research project, we aim to evaluate the relative effectiveness of state-of-the-art deep domain adaptation techniques. In particular, we will integrate a rich array of state-of-the-art deep domain adaptation techniques within one integrated platform. Thereafter, we will conduct a thorough empirical study evaluating relative effectiveness of these domain adaptation techniques under different image data scenarios: large amount of data, small amount of data, labeled data, unlabeled data, few classes, noisy data, among other characteristics. The ultimate aim is to provide the community with a reference and toolbox for choosing the most appropriate model that best fits their particular application scenario.

**74. Shijian Li**
**Sync-Switch: Hybrid Parameter Synchronization for Distributed Deep Learning**
Department: Computer Science
Advisor: Tian Guo
Degree Level: Ph.D.
Keywords: Distributed deep learning, Synchronization policy design, Empirical performance optimization
Description: A novel approach for designing a hybrid synchronization protocol to accelerate distributed deep learning. Our approach can achieve better trade-off in performance comparing to popular baseline, as well as other state-of-the-art approaches. Additionally, our approach can be used in the volatile cloud environment to mitigate the straggler problem.

**75. Zhenyuan Liu**
**Post-Silicon Measurement on AES in Power Side Channel Attacks**
Department: Electrical & Computer Engineering
Advisor: Patrick Schaumont
Degree Level: Ph.D.
Keywords: Side-channel Attack, Hardware Security, Post-silicon measurement, Correlation Power Analysis
Description: Side-channel attack extracts secrets information (key) from a chip or a system, through measurement and analysis of physical parameters (unintentionally), such as sound, power consumption, execution time. In this work, we are performing power side channel attacks on two in-house System-on-Chips. The target algorithm of our attack is the Advanced Encryption Standard (AES), which is a symmetric block cipher chosen by the U.S. government to protect classified information.

**77. Shruti Mahajan**
**BlankieChat: For co-located Parent-Child quality time in an augmented reality world with soft knitted sensors**
Department: Computer Science
Advisor: Erin Solovey
Degree Level: Ph.D.
Keywords: Augmemted Reality, Soft Knitted Touch Sensors, Parent-child conversations, Emotional Awareness, Closeness
Description: Communicating emotions and spending quality time together is an essential part of childrens' wellbeing and development. The communication gaps can be filled by developing tools that promote co-location, play, and comfort. We propose "BlankieChat," a blanket with AR and touch sensing capabilities. BlankieChat is meant to encourage children to express themselves and talk about their feelings with their parents. The blanket comes alive through AR with cartoons that each represent a mood, place, or thing. We hope to combine this co-located social AR technology with our existing soft knitted fabric-based touch sensors embedded in the child's blanket. Knitted fabric sensors are an ideal fit because they would be comforting and user-friendly for children, while still serving as their emotional security blanket.

**78. Hamid Mansoor**
**ARGUS: Interactive visual analysis of disruptions in smartphone-detected Bio-Behavioral Rhythms**
Department: Computer Science
Advisor: Emmanuel Agu
Degree Level: Ph.D.
Keywords: Interactive visual analytics, Circadian rhythms, Smartphone-sensed data
Description: Smartphones can detect behavioral cycles such as sleep-wake patterns that have an important bearing on mental and physical health. ARGUS is an interactive visual analytics framework to enable analysts to not only find but also explain breaks in smartphone-sensed behavioral patterns.

**79. Christopher Micek**
**Toward Understanding Effects of Digital Jury Moderation on the Polarization of Social Media Users**
Department: Computer Science
Advisor: Erin Solovey
Degree Level: Ph.D.
Keywords: social media, democracy, content moderation, polarization
Description: Polarization on social media has increased dramatically in recent years, propelled by the increased prevalence of disinformation, inflammatory rhetoric, and harassment online. As content moderation plays an important role in determining which types of content are acceptable and how prominently they are shown, examining how content moderation decisions impact users of social media and whether current moderation practices could be improved might inform changes to help mitigate the harms caused by such content. Our work investigates how a social media platform employing traditional, top-down moderation would impact the polarization of its users in comparison to a peer-based "digital jury" moderation system, which makes platform users active participants in digital governance.

**80. Sam Ogden**
**CremeBrulee: Scaling Deep Inference via Model-Level Caching**
Department: Computer Science
Advisor: Tian Guo
Degree Level: Ph.D.
Keywords: Resource Management, Deep Learning Models, Mobile Workload
Description: The work focuses on how to handle a large number of diverse requests for deep learning models. Mobile devices generate a lot of network requests for a large number of models and to improve resource management we need to consider both their workload and the deep learning models themselves.

**81. Ethan Prihar**
**Common Trends in Online Educational Experiments**
Department: Data Science
Advisor: Neil Heffernan
Degree Level: Ph.D.
Keywords: Tutoring, Education, Experimentation
Description: The online learning platform ASSISTments has been running dozens of experiments within the platform that evaluating different educational pedagogies. This work analyzes these experiments as a whole and identifies common trends in the effectiveness of different tutoring strategies.

**82. Raysa Rivera-Bergollo**
**Using Problem Similarity to Automatically Score Out-Of-Sample Problems' Open-Ended Responses**
Department: Computer Science
Advisor: Neil Heffernan
Degree Level: Master's
Keywords: Natural Language Processing, ASSISTments, Automatic Scoring, Open-ended Responses
Description: This research seeks to improve automatic scoring open-ended responses in mathematics specifically for problems without enough labeled data. Problems without a scoring history are suggested scores based on a simple fallback model which uses frequency of words in the student response. With this work, we seek to improve the baseline by investigating problem similarity to gain insights on these out-of-sample problems.

**83. Ronak Sankaranarayanan**
**Synthetic Generation of data for Human Context Recognition using Image-to-Image translation GANs**
Department: Data Science
Advisor: Emmanuel O Agu
Degree Level: Master's
Keywords: Data Augmentation, GANs, Time series Data, HCR, Time-to-Image
Description: Image to image GANs have previously been proposed to translate images from one image domain to another. E.g. to age a person's face. We innovatively utilize image to image GANs for generating synthetic smartphone data for Human Context Recognition. We describe our methodology, systematic evaluation and results.

**84. Abhishek Shivdeo**
**Cardiac Assessment using Video-Based Neural Network Models on Echocardiograms**
Department: Robotics Engineering
Advisor: Emmanuel Agu
Degree Level: Master's
Keywords: Deep Learning, Computer Vision, Medical Imaging, Echocardiograms, Video Analysis
Description: Echocardiography captures live videos of the heart that can be used to analyze the health of the heart. In our research, we systematically explore state-of-the-art using Video-based neural networks for echocardiogram analyses.

**85. Yao Su**
**ABN: Anti-Blur Neural Networks for Multi-Stage Deformable Image Registration**
Department: Data Science
Advisor: Xiangnan Kong
Degree Level: Ph.D.
Keywords: Deformable image registration, Medical image processing, Deep neural networks
Description: Deformable image registration is an important task in medical image processing, which seeks to align multiple images into the same coordinate system through nonlinear transformation techniques. Recently there is a surge of interest in the use of multi-stage deep neural networks to gradually deform images to the desired shape, because of their superior performance. However, conventional methods often repeatedly interpolate the image by only considering the previous generation output, which can blur the image and suppress details. In this work, we propose a novel multi-stage deep learning approach to overcome this problem, called Anti-Blur Network (ABN).

**86. Jidapa Thadajarassiri**
**Knowledge Amalgamation for Multi-Label Classification via Label Dependency Transfer**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: Knowledge Amalgamation, Teacher-Student Model, Multi-Label Classification
Description: We propose Adaptive Knowledge Transfer (ANT) to amalgamate multiple pre-trained multi-label models (teachers) into a single student model. Our aim is to train the student that becomes an expert in classifying labels from the union of teachersâ€™ specialized labels. This is achieved by adaptively transferring label dependency knowledge captured differently between teachers.

**87. ML Tlachac**
**StudentSADD: Student Suicidal Ideation and Depression Detection Dataset**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: mental health, machine learning, transfer learning, audio classification, data collection
Description: The COVID-19 pandemic has only further exacerbated the increasing rates of depression and suicidal ideation among college students. Given the need for universal mental illness screening technology for this population, we collected voice recordings and text from over 300 college students. Audio Assisted BERT yielded the highest screening results with unscripted audio recordings.

**88. Peter VanNostrand**
**FACET: Explaining Tree Ensembles with Counterfactual Examples**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: Explainable AI, Counterfactual Explanation, Ethical AI, Tree Ensembles,
Description: As machine learning systems are often tasked with important decision-making tasks there is a need for understanding the way these systems function. In particular users often ask questions like "Why was decision A made rather than decision B?" In this work we answer this question for decisions made by tree ensembles by finding hypothetical cases - called counterfactual examples - where the system would have made a different decision. By comparing these examples to the observed case we can determine what factors were important in making the original decision and make recommendations for changing that decision if desired.

**89. Eric Vertina**
**MXenes & Machine Learning**
Department: Data Science
Advisor: Oren Mangoubi
Degree Level: Ph.D.
Keywords: MXenes, Machine Learning, Materials Informatics, 2-dimensional materials, Density Functional Theory
Description: The parameter space of new materials and materials properties to explore is extremely large, and non-linear dimensional reduction and other unsupervised learning approaches present a promising approach to identifying the most promising 2D structures for specific applications. In this work, we will combine first-principles electronic structure theory, multi-scale methods and data-driven machine and deep learning approaches with fabrication and experimental characterization of selected identified 2D structures (MXenes) to validate and provide feedback to the models that will be developed to predict relevant 2D material parameters: electrical conductivity, carrier density, mobility, life-time, sensitivity to disorder, and others.

**90. Yanzhao Wang**
**Iterative algorithm for Spatio-temporal streaming data outbreak detection**
Department: Applied Statistics
Advisor: Yanzhao Wang
Degree Level: Ph.D.
Keywords: Anomaly detection, Bayesian hierarchical model, Spatio-temporal data, Information borrowing
Description: We propose an iterative algorithm with a Bayesian framework as a baseline to screen out the anomalies in the streaming multivariate spatial time series data. Using the spatial and temporal association between the data points, we are able to update the outbreak score at the different locations and achieve robust outbreak detection with a customized threshold.

**91. Biao Yin**
**Masked Autoencoder for Scientific Corrosion Assessment**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: Corrosion Assessment, Small Data, Computer Vision, Masked Autoencoder, Data Augmentation
Description: Masked autoencoder is a newly proposed scalable self-supervised learner for computer vision. It declares to allow high-capacity models that generalize well on open image dataset, like ImageNet-1K data. However, we found this model cannot provide promising results on our small image dataset for corrosion assessment. We then verified that certain domain-specific modifications are still necessary to be involved in order to fill this gap.

**92. Dongyu Zhang**
**Human-like Explanation for Text Classification With Limited Attention Supervision**
Department: Data Science
Advisor: Elke Rundensteiner
Degree Level: Ph.D.
Keywords: Model Explainability, Text Classification, Joint Learning, Attention Mechanism
Description: Human-like explanation for text classification is essential for high-impact settings such as healthcare where human rationales are required to support specialists' decisions. In this work, we design a deep learning architecture to adaptively learn attention weights that focus on words analogous to a human with very limited attention supervision. This method effectively unifies joint learning improving both tasks of text classification and human-like explanation even with only insufficient supervision labels for the latter task.

## *Life Sciences and Bioengineering*

**93. Christina Campagna**
**A novel role for RIC-8 in primary cilia morphogenesis**
Department: Biology & Biotechnology
Advisor: Inna Nechipurenko
Degree Level: Ph.D.
Keywords: cilia, neurons, C. elegans, heterotrimeric G proteins
Description: Primary cilia are specialized signaling organelles that extend from the surface of most mammalian cell types, including neurons, and play critical roles during development and in the adult tissues. Defects in cilia structure and function commonly manifest in neurological deficits such as intellectual disability and impaired sensory functions; however, the mechanisms that regulate cilia function in neurons are poorly understood. The goal of my project is to define a novel molecular pathway required for neuronal cilia morphogenesis using the nematode C. elegans and cultured mammalian cells.

**94. William DeMaria**
**Development of an in vitro human tissue engineered blood vessel**
Department: Biomedical Engineering
Advisor: Marsha Rolle
Degree Level: Ph.D.
Keywords: tissue engineering, cardiovascular, stem cells, co-culture
Description: The ultimate goal of this project is to create a functional, human tissue engineered blood vessel (TEBV) from cells only (i.e., no scaffold or foreign materials) to model vascular diseases such as cerebral aneurysm in vitro. The novelty of this TEBV is that it relies on modular tissue self-assembly from two co-seeded cell types: human mesenchymal stem cells (differentiated into vascular smooth muscle cells) and endothelial cells, both of which mimic the native cell types found in human blood vessels.

**95. Elizabeth DiLoreto**
**Traumatizing Worms to Understand PTSD in Humans**
Department: Biology & Biotechnology
Advisor: Jagan Srinivasan
Degree Level: Ph.D.
Keywords: C. elegans, Post Traumatic Stress Disorder, Associative Learning, Model System
Description: Half the population will experience trauma in their lifetime and 1 in 20 people will develop Post Traumatic Stress Disorder. To understand how trauma changes behavior and brain function, the roundworms C. elegans are being used to model the effects of trauma. Using this model, it will be possible to probe how changes in the brain during a traumatic event result in long term behavioral shifts.

**96. Antonia Dinicu**
**Effect of Shear Stress on Secondary Metabolilte Production**
Department: Chemical Engineering
Advisor: Susan Roberts
Degree Level: Master's
Keywords: Planct Cell Culture, Taxus Cells, Mechanical Shearing, Paclitaxel Quantification, Aggregate Size
Description: This poster is about examining the relationship between a compound of interest and different stressors. A combination of stressors was found to yield the highest level of the compound of interest.

**97. Johanna Enzmann**
**Additive Manufacturing of Scaffold Unit Pores for Bone Regeneration**
Department: Biomedical Engineering (MEng)
Advisor: Catherine Whittington
Degree Level: Master's
Keywords: Bone Regeneration, Additive Manufacturing, Scaffold based Tissue Engineering
Description: The area of focus is looking at the manipulation of geometric configurations of the scaffold to determine cell behavior in cells important to the bone regeneration process. More specifically, this work uses 3D printed segments of scaffold architectures that have been distilled down to their individual unit size with a balance between 2D and 3D features. These singular units will be used as a predicative tool to study the relationship of curvature in that single scaffold pore construct and its effects on cell behavior across Osteoblasts, Endothelial Cells and Fibroblasts.

**98. Andre Figueroa Milla**
**Bioprinting Cells to Engineer Blood Vessels In Vitro**
Department: Biomedical Engineering
Advisor: Marsha Rolle
Degree Level: Ph.D.
Keywords: Bioprinting, Tissue Engineering, Cell-only, Vascular, Biomanufacturing
Description: Fabricating blood vessels in a lab could be the solution to replace diseased tissues or to create models that better predict how drugs perform in humans. The overall goal of my project is to bioprint cells layer-by-layer to form a 3D construct, and culture it in vitro using conditions that mimic a human blood vessel. I am particularly interested in understanding how bioprinting process parameters affect tissue formation and function.

**99. Weikang Fu**
**Trac-looping, a novel method to revel chromatin high-order structure map**
Department: Biology & Biotechnology
Advisor: Amity L. Manning
Degree Level: Ph.D.
Keywords: Trac-looping, chromatin high-order structure, chromatin interaction
Description: Eukaryotes have complex and highly dynamic chromatin high-order structure, which allow them to gain survival advantages by regulating genes to produce advantageous traits in a short time and pass these traits to offspring. It's critical to revel chromatin high-order structure maps to utilize these mechanisms. Traditional methods of chromatin high-order structure researches suffer from low throughput and resolution. Here we are going to introduce a novel method, Trac-looping (transposase-mediated analysis of chromatin looping).

**100. Shang Gao**
**In-Vivo Demonstration of Photoacoustic Necrotic Region Mapping for Radiofrequency Cardiac Ablation Guidance**
Department: Robotics Engineering
Advisor: Haichong Zhang
Degree Level: Ph.D.
Keywords: Photoacoustic Imaging, RF Ablation, Image Guided Intervention, Cardiac, In-vivo
Description: Radiofrequency ablation is an effective minimally invasive therapy for diseases including cancer and cardiac arrhythmia by heating the problematic lesions using an electric current. We introduce a photoacoustic-based necrotic region mapping, focusing on visualizing the extent of ablation-induced necrosis and its lesion distribution. This real-time visual feedback on the growth of the ablation necrotic region is expected to reduce recurrence and procedural complications by avoiding incomplete and excessive ablation, respectively. The experiment result demonstrated the identification of the ablated cardiac tissue on the in-vivo swine heart.

**101. Logan Gaudette**
**Risk Factors for Metatarsal Stress Fracture Formation**
Department: Biomedical Engineering
Advisor: Karen Troy
Degree Level: Master's
Keywords: Biomechanics, Stress Fractures, Metatarsals, Motion Capture, OpenSim
Description: Runners who averaged over 15 miles a week were enrolled in the study to determine the effects of foot structure and function on risk of stress fracture formation. Motion capture markers were attached to study participants while they performed a variety of running and jumping related tasks. The recorded data was inputted into a biomechanics modeling software to calculate the forces acting on the bones in the foot during these activities.

**102. Enxhi Jaupi**
**Automated Ultrasound Computer Tomography imaging for Tissue-Engineered Blood Vessel**
Department: Biomedical Engineering
Advisor: Haichong Zhang
Degree Level: Master's
Keywords: Ultrasound Computer Tomography, Tissue-engineered blood vessels, Bioreactor, Tissue Imaging
Description: Discoveries and advancements in biomedical-engineering technology have allowed tissues to be made artificially from human cells. However, with 3D bioprinting, bioreactors have expanded application possibilities from engineered tissues to model diseases. One example is the fabrication of tissue-engineered blood vessels. Blood vessels are important Tissue in the human body that can be artificially engineered to facilitate the development of treatment plans for vascular diseases or even to transplant the damaged Tissue. One important factor for engineered Tissue is to monitor the growth, from biomaterial to construct Tissue. Due to its properties and shape, engineered Tissue needs flexible imaging methods for monitoring in a non-destructive and quantitative way. In addition, engineered Tissue needs a three-dimensional and time-lapse in vivo analysis to analyze its geometrics parameters and the quality of the tissue pre-construction and after. Therefore, ultrasound technology is the most suitable option for monitoring tissue-engineered blood vessels because of its real-time imaging capacity and zero radiation emission. We are building an Automated Ultrasound Computer Tomography Imaging Device specifically designed to monitor engineering tissue Blood Vessel at any stage. The device tackles the parametrization condition for monitoring the growth of Tissue engineering Blood Vessel in non-invasive and non-destructive ways. In addition, we aim for the most suitable resolution, scanning depth, and latency combinations to monitor tissue-engineered blood vessels.

**103. Athenia Jones**
**Modeling the Progressively Stiff Fibrotic Tumor Microenvironment of Pancreatic Ductal Adenocarcinoma**
Department: Biomedical Engineering
Advisor: Catherine Whittington
Degree Level: Ph.D.
Keywords: Tumor Microenvironment, Tissue Engineering, Collagen, Disease Model, Fibrosis
Description: Pancreatic ductal adenocarcinoma is an incredibly deadly and challenging cancer to treat due to the physical features of the tumor tissue. In vitro models offer a solution to understand the complex interactions of tumor cells and their surrounding environment in order to develop better treatments. Our lab focuses on recapitulating the progressive tissue stiffening that occurs during disease and so we can understand how it influences the progression of pancreatic cancer.

**104. Kevin Keating**
**Development of an automated, high-throughput cloning pipeline**
Department: Chemical Engineering
Advisor: Eric Young
Degree Level: Ph.D.
Keywords: synthetic biology, genetic engineering, nonmodel organisms
Description: This work seeks to expand recent advances in synthetic biology to nonmodel organisms. A modular, automated cloning strategy enables rapid construction and characterization of engineered strains of Gram-negative bacteria other than E.coli.

**105. Hanson Lee**
**Developing Neuromuscular Junctions with 3D Fibrin Architecture of Innervated Skeletal Muscle Fibers**
Department: Biomedical Engineering
Advisor: George Pins
Degree Level: Ph.D.
Keywords: Tissue Innervation, 3D Tissue Engineering, Neuromuscular Junction, Skeletal Muscle Regeneration, Organized Tissue Formation
Description: To discover skeletal muscle therapies, we need to model how our body engineers our skeletal muscles. We are interested in recreating a system that outlines how the nervous and skeletal muscle systems interact to develop functional muscle tissue.

**106. Caroline Muirhead**
**Genetic sex governs sex-specific behavior in C. elegans**
Department: Biology & Biotechnology
Advisor: Jagan Srinivasan
Degree Level: Ph.D.
Keywords: C. elegans, genetic sex, behavior
Description: The two sexes of C. elegans exhibit sex-specific behaviors. Reversing the sex of the nervous system, but not the worm body, changes sex-specific behavior, indicating that genetic sex has a role in determining sex-specific behaviors.

**107. Md Tahsin Rahi**
**Functional Characterization of Paclitaxel Transporters in Taxus cuspidata**
Department: Chemical Engineering
Advisor: Susan Roberts
Degree Level: Ph.D.
Keywords: Paclitaxel, ABC transporter, Taxus cuspidata, Biosynthetic pathway
Description: Paclitaxel, which is widely used as anticancer drug, is a naturally produced metabolites in Taxus cuspidata cell lines. However, the transport of paclitaxel from within the cell to the cellular membrane and further into the media is a major bottleneck for biosynthesis of paclitaxel. In this study, we aimed to characterize transporter genes that are responsible for transporting paclitaxel so that we can further genetically engineered taxus cell line with specific transporter gene to increase the yield of paclitaxel production.

**108. Brian Ruliffson**
**Materials for a progressively stiffening extracellular matrix to model in vitro lymphangiogenesis during fibrotic progression**
Department: Biomedical Engineering
Advisor: Catherine Whittington
Degree Level: Ph.D.
Keywords: Fibrosis, Tissue Engineering, Disease Model, Lymphangiogenesis, Collagen
Description: We are creating a disease model of fibrosis that includes a progressively stiffening material to mimic the way fibrosis progresses within the body. This progressive stiffness has not yet been included in any models of fibrosis to date and could represent a key component of fibrosis that has been left out of models historically. We seek to use this model to study the growth of lymph vessels during fibrotic progression, an important process related to many diseases such as cancer, kidney disease, and lymphedema.

**109. Julia Ryan**
**Defining the Roles of Three Putative RNA-Binding Proteins in the Mycobacterium smegmatis Stress Response**
Department: Biology & Biotechnology
Advisor: Scarlet Shell
Degree Level: Ph.D.
Keywords: mycobacteria, tuberculosis, RNA-binding proteins, post-transcriptional regulation, RNA degadation
Description: Mycobacterium smegmatis is a model organism used to study the basic biology of mycobacteria, a diverse group of bacteria that cause diseases including tuberculosis, leprosy, and other diseases of the skin and soft tissues. One response pathogenic mycobacteria have to the stressful conditions they face during infection is to stabilize their transcriptome by globally decreasing RNA degradation. Our lab has identified three predicted RNA-binding proteins that we believe are involved in this response, and I am going working towards determining what their functions are.

**110. Bryanna Samolyk**
**Development and Characterization of Biomimetic Fibrin Scaffolds for Skeletal Muscle Engineering**
Department: Biomedical Engineering
Advisor: George Pins
Degree Level: Ph.D.
Keywords: Fibrin, Skeletal Muscle, Tissue Engineering, Scaffold, Cellular Alignment
Description: This project is investigating biomimetic scaffold fabrication to improve skeletal muscle regeneration for volumetric muscle loss. Scaffold characterization, including evaluation of mechanical properties and architectural features as well as evaluation of myotube formation and alignment is the main focus.

**111. Huaming Sun**
**Using machine learning to understand the determinants of mRNA stability in mycobacteria**
Department: Bioinformatics & Computational Biology
Advisor: Scarlet Shell
Degree Level: Ph.D.
Keywords: machine learning, mRNA degradation, mycobacteria
Description: We develop machine learning models to identify the factors determine mRNA degradation in mycobacteria and to study how these factors regulate degradation.

**112. Richard Thyden**
**An edible decellularized plant based macro carrier for scaling scaling production of lab grown meat**
Department: Biomedical Engineering
Advisor: Tanja Dominko
Degree Level: Ph.D.
Keywords: Lab grown Meat, Decellularized plants, Skeletal muscle, Satellite cells
Description: Scaling production of cultured meat will require creative thinking in engineering bioreactors and cell scaffolding. It will be advantageous that cell scaffolding is cheap, edible, recognizable, and conducive for cell growth. We explore the ability to attach and grow muscle cells using decellularized plant derived macro carriers, using techniques in microscopy, dna quantification, and material characterization.

**113. Andrew Wilzman**
**Can single-leg drop landings outperform double-leg in building bone?**
Department: Biomedical Engineering
Advisor: Karen Troy
Degree Level: Ph.D.
Keywords: Bone, Motion Capture, Biomechanics, Finite Element Analysis, Strain
Description: In this motion capture study, we aim to determine the degree in which number of landing limbs and drop height affect the magnitude of bone growth signaling measured by the Osteogenic Index (OI), as well as how they affect calculated joint shear forces.

**114. Bryhannah Young**
**Kinetics and Kinematics of Exoskeleton-assisted walking devices on spinal cord injury patients**
Department: Biomedical Engineering
Advisor: Karen Troy
Degree Level: Master's
Keywords: walking device, spinal, injury, exoskelton, devices
Description: This research is a subset of a larger clinical trial that investigates the effects of exoskeleton-assisted walking therapy on people with spinal cord injury. Once calculating the inverse dynamics of the gait cycles for each participant, bone growth can be calculated to show the effectiveness of the exoskeleton device therapy.

## *Mathematical, Chemical, and Physical Sciences*

**115. Teagan Bate**
**Mixing of active and passive fluids in microtubule-kinesin active fluid system**
Department: Physics
Advisor: Kun-Ta Wu
Degree Level: Ph.D.
Keywords: Active-Passive, Multi-fluid, Mixing, Mesoscale
Description: Fluid mixing is driven by the passive process of diffusion and the active process of stretching and folding, which homogenize the system’s constituents. Conventionally, the active process is applied via external shearing machines such as a kitchen stand mixer. However, applying external shearing becomes more challenging in mesoscopic fluid systems due to the increasing difficulty of controlling the injection of energy on the micron scale. To overcome this challenge, we introduced microtubule-kinesin active fluid to power the active mixing process. To demonstrate its mixing capability, we created a multi-fluid system where active fluid is adjacent to an inactivated, passive fluid and allowed the active fluid to blend with the passive fluid until the system reaches a homogeneous state. We found that the mixing dynamics of such active-passive fluid mixing was dominated by the passive process of diffusion, until the activity of active fluid was tuned to be sufficiently high and the active processes of active fluid begin to dominate the mixing process. Our work will stimulate the development of utilizing active fluid to accomplish mesoscale mixing tasks in multi-fluid systems at the micron scale. We acknowledge support from the National Science Foundation (NSF-CBET-2045621).

**116. Debanik Das**
**Modeling phononic crystals to tailor phonon influence in the quantum devices**
Department: Physics
Advisor: L. Ramdas Ram-Mohan
Degree Level: Ph.D.
Keywords: phononic crystal, bandgap, quantum devices, optimization, finite element method
Description: The phonon is the physical particle representing the quantized mechanical vibration and is responsible for the transmission of sound and heat. Materials with patterned holes or inclusions to control the phononic properties are called phononic crystals. Modelling phononic crystals with specific bandgaps is a key element to create a phonon-isolated environment for a quantum device which needs electron spin-coherence for longer time.We present a novel numerical method to efficiently model such systems using a subspace diagonalization technique. This reduces considerable computational time while creating a large training data for machine learning.
As the phononic systems are theoretically scale invariant, in addition to the microscopic devices, this also lays the groundwork for better control of the ultrasound energy in specific locations in biological systems.

**117. Ashley Lockwood**
**Multinomial-Dirichlet Model with Stick-Breaking Weights**
Department: Applied Statistics
Advisor: Balgobin Nandram
Degree Level: Ph.D.
Keywords: Multinomial-Dirichlet model, Stick-breaking weights, Logistic regression, Bayesian statistics, Metropolis sampler
Description: My presentation is an illustration demonstrating how to use the multinomial-Dirichlet model with stick-breaking weights to make inference about the characteristics of a population. I show the advantages of this type of model compared to using the classic logistic regression model. Both models in this example use BMI data to predict the proportion of obesity in California.

**118. Elisa Negrini**
**A Neural Network Ensemble Approach to System Identification**
Department: Applied Mathematics
Advisor: Luca Capogna
Degree Level: Ph.D.
Keywords: Deep Learning, Neural Network Ensemble, System Identification, Ordinary Differential Equations, Regularized Network
Description: We present a new algorithm for learning unknown governing equations from trajectory data, using and ensemble of neural networks. Given samples of solutions x(t) to an unknown dynamical system x'(t)=f(t,x(t)), we approximate the function f using an ensemble of neural networks. We express the equation in integral form and use Euler method to predict the solution at every successive time step using at each iteration a different neural network as a prior for f. This procedure yields M-1 time-independent networks, where M is the number of time steps at which x(t) is observed. Finally, we obtain a single function f(t,x(t)) by neural network interpolation. Unlike our earlier work, where we numerically computed the derivatives of data, and used them as target in a Lipschitz regularized neural network to approximate f, our new method avoids numerical differentiations, which are unstable in presence of noise. We test the new algorithm on multiple examples both with and without noise in the data. We empirically show that generalization and recovery of the governing equation improve by adding a Lipschitz regularization term in our loss function and that this method improves our previous one especially in presence of noise, when numerical differentiation provides low quality target data. Finally, we compare our results with other methods for system identification.

**119. Guillermo Carlo Nunez**
**The maximal determinant problem**
Department: Applied Mathematics
Advisor: Padraig Ó Catháin
Degree Level: Ph.D.
Keywords: Linear Algebra, Number Theory, Combinatorics, Applications of Algebra, Statistics
Description: If a matrix has entries in the complex unit sphere, how large can its determinant be? Perhaps surprisingly knowing the largest value has a wide range of applications. We will present classic results, applications and our extension of the theory involving connections to Number Theory.

## *Robotics Engineering, Cyberphysical Systems, Electrical and Computer Engineering*

**120. Keshav Bimbraw**
**Reconstruction of hand motion using ultrasound images from the forearm**
Department: Robotics Engineering
Advisor: Keshav Bimbraw
Degree Level: Ph.D.
Keywords: Medical Robots and Systems, Human Centered Robotics, Rehabilitation Robotics, Human Computer Interaction, Prosthetics and Exoskeletons
Description: Ultrasound images of the forearm offer a way to visualize the internal physiology of the hand from a musculoskeletal perspective. Recent work has shown that these images can be classified using machine learning to predict various hand configurations. In this work, I describe a Convolutional Neural Network (CNN) based deep learning pipeline for predicting the MCP joint angles and a machine learning based pipeline for predicting hand configurations.

**121. Joshua Bloom**
**Stabilizing Environmental Non-Stationarity in Multi-Agent Reinforcement Learning via Intention**
Department: Robotics Engineering
Advisor: Carlo Pinciroli
Degree Level: Ph.D.
Keywords: Reinforcement Learning, Multi-Robot Systems, Swarm Robotics, Collective Transport, Machine Learning
Description: We present a Multi-Agent Reinforcement Learning approach using intention to minimize non-stationarity in partially observable environments with minimal communication. Our intention method reduces training steps while increasing performance by reducing the environmental unknowns through a learned joint intention. We show the viability of this method on a collective transport task and contrast system behaviors with minimalistic methods.

**122. Shreyas Chandra Sekhar**
**automating endoscopic movement**
Department: Robotics Engineering
Advisor: Gregory S Fischer
Degree Level: Master's
Keywords: endoscope, robot control, reinforcement learning, augmented reality
Description: The goal of this Research is to model and train the endoscopic camera pose to predict and move the camera pose based on current Surgeon pose and Surgeon’s instrument motion. This would be done by identifying the current subtask of the Surgeon, track the eye movement and gesture to predict the next possible action. This estimate would be used move the camera to provide the most appropriate subject scene.

**124. Albert Enyedy**
**Visual Feedback-Based Arm Motion for Atlas Robot in Simulation**
Department: Robotics Engineering
Advisor: Michael Gennert
Degree Level: Ph.D.
Keywords: humanoid, motion, vision, robotics
Description: In order for robots to operate effectively in real-time in the real world, they must be able to act and react quickly, without pausing to compute. We propose a novel method for controlling arm movement on WPI's Atlas robot in simulation by using visual feedback. The expected increased calculation speed presents the opportunity for improving the speed and accuracy with which the robot can react to and interact with its environment.

**125. Nathaniel Goldfarb**
**Sliding Mode Controller For Assistive Exoskeleton Controller**
Department: Robotics Engineering
Advisor: Gregory Fischer
Degree Level: Ph.D.
Keywords: exoskeleton, assistive, controller
Description: Exoskeleton assistive controllers should provided the necessary torque to help aid in motion. They need to help the person wearing the exoskeleton follow a desired motion and be robust to effort provided by the person.

**126. Avnish Gupta**
**Grasping unknown novel objects using active vision**
Department: Robotics Engineering
Advisor: Berk Calli
Degree Level: Master's
Keywords: Novel Robotic Grasping, Active Vision, Reinforcement Learning
Description: The aim to build an intelligent robotic system which is capable of grasping unknown novel objects using active vision with camera on the robot arm.

**127. Robin Hall**
**Combating Failures in Underwater Species Reproduction with a Soft Robotic Fish**
Department: Robotics Engineering
Advisor: Cagdas Onal
Degree Level: Ph.D.
Keywords: bioinspiration, underwater, climate, soft
Description: Rising ocean temperatures due to climate change threaten to impede the reproduction of up to sixty percent of fish species. With the longer-term goal of developing a tetherless and widely accessible biologically inspired soft robotic fish that can monitor the temperature variation with very high density and without affecting the natural life, we propose a cable-actuated 3D-printed wave spring tail that will be used to propel the robot via undulatory locomotion.

**128. Amin Hazrati Marangalou**
**Wireless power transmission for implantable microelectronic devices**
Department: Electrical & Computer Engineering
Advisor: Ulkuhan Guler
Degree Level: Ph.D.
Keywords: Voltage rectifier, Wireless power transmission (WPT), Implantable medical devices (IMDs), Inductive power transmission
Description: Implantable microelectronic devices (IMDs) powered by internal batteries suffer from their large volume, limited lifetime, replacement hardship, and cost. Therefore, wireless power transmission (WPT) techniques help to power the IMDs from outside the body.

**129. Burak Kahraman**
**Power and Accuracy Optimization for Luminescent Transcutaneous Oxygen Measurements**
Department: Electrical & Computer Engineering
Advisor: Ulkuhan Guler
Degree Level: Ph.D.
Keywords: Transcutaneous Oxygen, Respiration, Power, Accuracy and Precision, Decay Time
Description: This study investigates a newly emerged method which is suitable for wearable device technology for measuring partial pressure of oxygen diffused through the skin by performing different kind of experiments.

**130. Savita Vitthalrao Kendre**
**3D printing of soft robots**
Department: Robotics Engineering
Advisor: Markus P. Nemitz
Degree Level: Ph.D.
Keywords: FDM printing, Soft robots, Education, E-learning, Rapid prototyping
Description: Soft robots have shown great promise to carry humanoid tasks due to use of compliant materials. However the fabrication process of soft robot is cumbersome and time intensive due to multi-step replica molding. We demonstrate the use of 3D printing technology to fabricate soft robots.

**131. Ravi Kirschner**
**A Wireless, Fully Controllable System for Monitoring Cholinergic Systems in the Basal Forebrain and Hippocampus**
Department: Electrical & Computer Engineering
Advisor: Ulkuhan Guler
Degree Level: Master's
Keywords: Integrated Circuits, Optical Stimulation, Neural Interface, Cholinergic Neurotransmitters, Optical Recording
Description: Healthy cholinergic function is important for brain function, and disruption of the system is thought to be the cause of dementia, including Alzheimer's disease. Current monitoring systems are tethered, meaning the subjects are unable to act naturally. Our chip is designed to be a fully wireless, fully controllable system able to excite neurons and record their activity to determine the relationship between cholinergic function and memory disorders in naturally-behaving rats.

**132. Tsung-Chi Lin**
**Comparison of Haptic and Augmented Reality Visual Cues for Assisting Tele-manipulation**
Department: Robotics Engineering
Advisor: Zhi Li
Degree Level: Ph.D.
Keywords: Teleoperation, Telemanipulation, Haptic, Augmented reality, Motion tracking
Description: Robot teleoperation via human motion tracking has been proven to be easy to learn, intuitive to operate, and facilitate faster task execution than existing baselines. However, precise control while performing the dexterous telemanipulation task is still a challenge. We implement sensory augmentation in terms of haptic and augmented reality visual cues to improve the performance.

**133. Xihan Ma**
**Automatic robotic OCT imaging with extended scanning area for pre-transplant kidney screening**
Department: Robotics Engineering
Advisor: Haichong K. Zhang
Degree Level: Ph.D.
Keywords: OCT, medical imaging, robotic manipulator
Description: Pre-transplant evaluation is a key step to secure the success rate of kidney transplant surgery, where studies have shown that Optical Coherence Tomography (OCT) images can be a valid tool to screen the health condition of a kidney. We present a robotic OCT system by interconnecting an OCT probe conventionally for desktop usage only with a robotic manipulator to expand the OCT scanning area. In addition, an automatic scan path-planning pipeline is proposed so that no manual operation is required during the OCT scan process. The system is expected to evaluate the kidneyâ€™s health status more thoroughly based on OCT images with enlarged scan area and efficiently by leveraging the agility of the robotic manipulator.

**134. Kenechukwu Mbanisi**
**Multimodal Shared Autonomy Framework for Social Navigation Assistance of Telepresence Robots**
Department: Robotics Engineering
Advisor: Michael Gennert
Degree Level: Ph.D.
Keywords: Shared Autonomy, Human-Robot Interaction, Robot Navigation
Description: Mobile telepresence robots offer new opportunities for people to participate actively in activities at a distance. Our research focuses on providing navigation assistance to users in dense and cluttered environments to help them drive safely around people. The results of our study indicate participants preferred multimodal assistance to single-mode assistance.

**135. Tess Meier**
**Using fMRI to characterize neuro-rehabilitative potential of a hand exoskeleton-based therapy**
Department: Robotics Engineering
Advisor: Gregory Fischer
Degree Level: Ph.D.
Keywords: fMRI, rehabilitation, exoskeleton, hand, brain
Description: Function MRI (fMRI) is used to measure brain activation. By monitoring brain activation patterns during a variety of hand exoskeleton-based movements, we can try to understand how the motor system responds to therapy. This work lays the foundation for a understanding how this therapy effects functional reorganization of the brain after a traumatic brain injury.

**136. Fanxing Meng**
**Low-cost anthropomorphic hand and arm for humanoid robot**
Department: Robotics Engineering
Advisor: Michael Gennert
Degree Level: Ph.D.
Keywords: robot hand, robot arm, low-cost, anthropomorphic
Description: This work is part of an ongoing research project on building a low-cost humanoid robot. The hand design improves upon the open-source Parloma hand for additional degrees of freedom. The hand and wrist utilize servo motors for compactness and light-weight. Hydro muscles power the elbow and shoulder to achieve a high power-to-cost ratio.

**139. Nihal Suneel Navale**
**Integrating Robots with Speech Recognition to Perform Tasks**
Department: Robotics Engineering
Advisor: Zhi Jane Li
Degree Level: Master's
Keywords: Natural Language Processing, Robot, Human-Robot Interaction, Speech Recognition, ROS simulation
Description: Designing a social robot which can recognize and understand human speech and perform predefined tasks. The robot is set in an hospital environment and assists nurses, doctors, other staff of the hospital and visitors.

**140. Yichuan Tang**
**Mirror-Integrated Ultrasound Image-Guided Percutaneous Needle Intervention**
Department: Robotics Engineering
Advisor: Haichong Zhang
Degree Level: Ph.D.
Keywords: ultrasound imaging, image-guided intervention, percutaneous needle insertion, acoustic mirror
Description: Conventional ultrasound image-guided percutaneous needle intervention requires clinicians to hold the probe with one hand and insert the needle with the other hand, which challenges the clinician's ability to relate positions of the needle and the target anatomy mentally, making the procedure heavily operator-dependent. Such a burden on clinicians can be eased if the needle trajectory and image plane are registered throughout the needle insertion process, and we here propose an ultrasound imaging needle intervention system using an acoustic reflector and belt-pully system to register needle trajectory to the image plane. Compared to needle guides for ultrasound probes on the market, our approach provides a forward view of the needle and one extra rotational degree of freedom to facilitate finding the best insertion point, along with the potential to enable automatic intervention planning and execution.

**141. Tuna Tufan**
**A Fluorescent Sensing Film-Based Miniaturized Transcutaneous Carbon Dioxide Monitor**
Department: Electrical & Computer Engineering
Advisor: Ulkuhan Guler
Degree Level: Ph.D.
Keywords: Transcutaneous Carbon Dioxide, Fluorescent Sensing, Miniaturized Blood Gas Monitors, Smart and Connected Health
Description: Arterial blood gases, oxygen, carbon dioxide, and the potential of hydrogen are the key indicators of respiratory status and should be continuously monitored for patients whose respiratory vital signs may alter frequently and rapidly. The arterial partial pressure of oxygen and carbon dioxide can be estimated with transcutaneous monitoring, which measures the partial pressure of oxygen and carbon dioxide diffusing from the skin. We propose a miniaturized fluorescent sensing film-based prototype, envisioned as a first-of-its-kind continuous transcutaneous carbon dioxide monitoring wearable device.

**142. Achyuthan Unni Krishnan**
**Improve control precision of a free-form tele-manipulation interface**
Department: Robotics Engineering
Advisor: Zhi Li
Degree Level: Ph.D.
Keywords: Robot Teleportation, Human Robot Interaction, Robot Manipulation
Description: Motion tracking interfaces are intuitive and efficient for free-form teleoperation tasks. However, due to limited precision of human motion control and unintentional motion due to interference of different degrees-of-freedom of the control interface, control precision can be low. In this poster we present a user-study based design of developing control interfaces that improve control precision of tele-manipulation interfaces via motion mapping.

**143. He Wang**
**Advanced Electromyogram Signal Processing with an Emphasis on Simplified, Near-Optimal Whitening**
Department: Electrical & Computer Engineering
Advisor: Edward Clancy
Degree Level: Ph.D.
Keywords: DSP, Electromyogram signal, Whitening filter, Machine Learning, Differential Evolution (DE) algorithm
Description: Whitening can efficiently improve the estiamtion of Electromyogram (EMG) signal amplitude. However, previous whitneing technique requires complex calibrations to different subjects, which is very time consuming and incovenient. By applying the Differential Evolution (DE) algorithm to existing data, we managed to generate a 2nd-order universal IIR whitening filter which has similar performance compared to subject-specific whitening filters, but the universal filter is much less complex.