Celebrating Graduate Research

GRADUATE RESEARCH INNOVATION EXCHANGE (GRIE)

Annual Graduate Research Celebration

March 3-9, 2021

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, and Computer Science • 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 as well as Post-Doctoral Fellows 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.

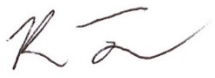
As you view pre-recorded presentations, you will see more than 175 graduate researchers representing a diversity of disciplines. They have prepared presentations that detail the research in which they are engaged, work that is aimed at broadening our understanding of the world around us and making it 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 5 minutes to less.
- No awards will be presented following this week. Instead, judges will select finalists to present live via Zoom on April 6. A panel of judges will determine winners after these presentations.

We hope you can join us for the GRIE finals on April 6, and that you enjoy our graduate researchers presentations this week.

Rory Flinn
Assistant Dean of Graduate Studies



Acknowledgements

Special thanks to…

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

- Our hardworking student support team

- 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:

Danielle Cote	Michael Demetriou	Zhi (Jane) Li
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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

Numerical Investigation of the Effect of Slot Jet Reattachment Nozzles on Paper Drying

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Ph.D.

Keywords: drying, paper, heat and mass transfer, ultrasound, porous media

Description: The paper drying process is very energy inefficient. It almost consumes one-third of the total energy used in papermaking. Ultrasonic dryers use vibrations instead of heat to dry wet porous media such as paper. This work's primary objective is to numerically illustrate the impact of the application of ultrasound mechanism on paper drying process performance under the given set of operating conditions.

2. Alexander Castaneda

Experimental Study of Flexible Electrohydrodynamic Conduction Pumping for Electronics Cooling

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Ph.D.

Keywords: Electrohydrodynamics, Fluid Mechanics, Flexible, Electronics Cooling, Conduction Pumping

Description: Modern electronics continue to develop and evolve as society shifts their focus towards more complex technologies, including small electronics for space applications. In turn, the thermal management systems of these modern electronics must adapt. Electrohydrodynamic conduction pumping presents a unique solution that is characterized by simplicity, low power, and a novel flexible design.

3. Li Chang

Nucleate Boiling Enhanced Pool Burning in Turbulence

Department: Fire Protection Engineering

Advisor: Ali Rangwala

Degree Level: Ph.D.

Keywords: Nucleate boiling, Pool burning, Bubble observation, Mass transfer

Description: Boiling is an effective way for both mass and heat transfer, which can be applied to improve the clean up efficiency of an oil spill burning process. The bubble carries a heavy role for the enhancement and this study explores the bubble behavior that couples to the combustion phenomena.

4. Nolan Dexter-Brown

Ignition Delay Effect on Deflagration to Detonation Transition

Department: Aerospace Engineering

Advisor: Jagannath Jayachandran

Degree Level: Ph.D.

Keywords: Combustion, Deflagration to Detonation Transition (DDT), Ignition Delay

Description: The goal of this study is to better understand how a flame initially traveling at subsonic velocities undergoes the transition to supersonic velocities as to ensure that this does not happen in industrial environments and fuel storage. This is done by carefully varying the combustible mixture composition to specifically control the ignition time and determine its effect on the transition from subsonic to supersonic flame propagation.

5. Kaoutar Diouri

Understanding the Stress Distribution and Fracture Failure of Asphalt Pavement during the Milling Process: Numerical, Laboratory- and Field-Investigation

Department: Civil Engineering

Advisor: Rajib B Mallick

Degree Level: Ph.D.

Keywords: Milling, rehabilitation, aging, stress- strain field, fragmentation

Description: Milling is a necessary step for the removal of aged Hot Mix Asphalt (HMA) materials and recovery of Reclaimed Asphalt Pavement (RAP) for the rehabilitation of asphalt pavements. Effective milling is the key to constructing sustainable pavements. The overall objective of this research study is to evaluate the structural capacity of the remaining milled pavement during and after this process under various conditions.

6. Kyle Gerlach

Assessment of Ferrate for Pre-Oxidation Treatment of Harmful Cyanobacterial Blooms in Drinking Water Treatment

Department: Environmental Engineering

Advisor: Jeanine Dudle

Degree Level: Ph.D.

Keywords: Drinking Water, Water Treatment, Cyanobacteria, Chemical Oxidation

Description: Harmful toxic cyanobacterial blooms are becoming more frequent in drinking water sources across the country and pose a potential threat to public health. This research aims to evaluate the use of Potassium Ferrate as a chemical pre-oxidant at drinking water treatment facilities to inactivate and remove cyanobacteria from drinking water.

7. Rafael Gutierrez

Efficient RF Cathode Design for Electric Thrusters

Department: Aerospace Engineering

Advisor: John Blandino

Degree Level: Ph.D.

Keywords: cathode, electric propulsion, radiofrequency

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 neutralization. The RF cathode will also enable the use of condensable propellants, providing improved options for spacecraft and mission designers.

8. Anass Harmal

Bioinspired Design for Tough Eco Friendly Cement

Department: Civil Engineering

Advisor: Harold Walker

Degree Level: Ph.D.

Keywords: Bioinspired, Geopolymer, Toughness, Brittleness, Eco Friendly

Description: Geopolymer Cement (GC) is one of the prominent alternatives for the more polluting Ordinary Portland Cement (OPC) used in construction. One of its main problems is brittleness that is three times higher than OPC. In this work, we get inspired from natural structures to design a tough eco friendly construction material by implementation of a series of toughening mechanisms present in nature.

9. Hamed Jafarishad

Optical Fiber Strain Sensor for Food during Drying Process

Department: Mechanical Engineering

Advisor: Yuxiang Liu

Degree Level: Ph.D.

Keywords: Optical Fiber, Strain Sensor, Food, Drying Process, Shrinkage

Description: This research is about the design and fabrication of an optical fiber strain sensor for measurements of food shrinkage during the drying process. As foods go through the drying process, they lose their moisture and consequently shrink. Measurements of this shrinkage can provide important data regarding changes in food properties that are beneficial to food companies.

10. Oussama Khouchani

Engineered geopolymer nanocomposites

Department: Civil Engineering

Advisor: Tahar El-Korchi

Degree Level: Ph.D.

Keywords: Geoplymer, compsites, nanoparticles

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

11. Andrei Koch

Pulsed Surface Plasma Source (PSPS) Design for Experimental Investigation of Flashover Plasmas

Department: Aerospace Engineering

Advisor: Nikolaos Gatsonis

Degree Level: Ph.D.

Keywords: Plasma, Spacecraft, Charging, Flashover

Description: Due to the charging environment spacecraft experience, electrical discharges known as flashover events have been observed to occur and pose significant risk of failure. While direct diagnostics techniques for these plasmas are being developed to better understand the plasma generated in these events as part of this research, repeatable generation of typical plasmas and environments typical of these flashovers must also be pursued. As part of this research, the development of a repeatable use, tunable plasma source capable of generating the plasma conditions and environmental interactions typical in space has been undertaken to allow for laboratory experimentation of these events.

13. Mucheng Li

Optical Fiber Sensors for Relative Humidity and Moisture Content Measurement

Department: Mechanical Engineering

Advisor: Yuxiang Liu

Degree Level: Ph.D.

Keywords: fiber optics, humidity sensor, moisture sensor, vibration-insensitive

Description: In this work, we are developing a vibration-insensitive fiber optical sensor based on lossy-mode resonances for measuring both relative humidity (RH) in air and moisture content in foods in order to address the urgent need for in-situ humidity and moisture content monitoring of food/pulp paper samples during the industry-scale drying process. Our optical sensor has a smaller size, faster response time, higher resolution, and better compatibility with the microwave dryer than the commercial electrical sensors. We have experimentally demonstrated the motion-insensitive RH measurement, indicating potential applications in the manufacturing process control in the food and pulp&paper industry to improve product quality and safety.

14. Ajit Mohekar

Fundamental Mechanisms of Energy Transport in Layered Electromagentic Heat Exchangers

Department: Mechanical Engineering

Advisor: Burt Tilley

Degree Level: Ph.D.

Keywords: electromagnetic heating, thermal runaway, multiphysics modeling

Description: Electromagnetic (EM) heat exchangers (HX) are devices that convert EM waves into heat or mechanical work. A ceramic material is heated by EM waves and a fluid flow is incorporated to transfer the dissipated thermal energy from the ceramic. This presentation is focused on investigating how efficiently compressible and incompressible fluids transfer heat from the ceramic.

15. Zahra Noori

Study of the Effect of Ultrasound Mechanism on Paper Drying

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Ph.D.

Keywords: Drying, Energy Efficiency, Ultrasound

Description: Drying consumes a large portion of energy in industry, about 16 % of total energy. Therefore, reducing the energy consumption and increasing the drying rate is very essential. In this research, a novel technique for drying, ultrasound drying, is introduced and the feasibility of that for paper drying has been investigated.

16. Nathaniel O'Connor

Thermal Analysis of Electrically-Driven Liquid Film Boiling in Microgravity

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Ph.D.

Keywords: Electrohydrodynamics, 113, Microgravity, Numerical Simulation

Description: One of the major concerns for future spacecraft and space communications systems is cooling of electronics, where microgravity poses a significant challenge to typical two-phase thermal management. Electrohydrodynamics is being explored as an innovative way to solve these challenges and to enable the future of electronics in space. This numerical work was developed to answer design questions and safety considerations for an upcoming experiment on the International Space Station testing this new technology.

18. Nick Pratt

Approaches to Inkjet Print Fine Electronic Circuits

Department: Mechanical Engineering

Advisor: Pratap Rao

Degree Level: Ph.D.

Keywords: Inkjet, Printed Electronics, Electronics Manufacturing

Description: Inkjet printing is a cheap and fast method for printing electronics. However, due to the large trace size (>100 um) and high trace resistance, it has not been widely adopted by industry as screen printing can match these trace widths with lower trace resistances. Here we have identified and provided preliminary results for 3 different inkjet approaches, mainly controlling substrate temperature and ink-substrate contact angle, to decrease the width of the current traces to less than 60 um with low resistance and less than 30 um with higher resistance.

20. Jake Scarponi

Magnesium Hydride Slurry as a Sustainable Aerospace Fuel - Atmospheric Effects

Department: Aerospace Engineering

Advisor: Jagannath Jayachandran

Degree Level: Master's

Keywords: Emissions, Aircraft, Particle dynamics

Description: The feasibility of using a MgH2 slurry as net-zero carbon dioxide-emitting aerospace fuel is investigated. The focus of this study is to understand the tendency of the combustion product MgO to react with atmospheric CO2 to produce the stable MgCO3 at high altitudes. Timescales and limitations of this process are explored.

21. Yao Shen

Fiber-Based Optical Trapping for Physical and Biological Study in Liquid and Gas Environments

Department: Mechanical Engineering

Advisor: Yuxiang Liu

Degree Level: Ph.D.

Keywords: optical trapping, optical tweezers, airborne particles, cancer cell

Description: Optical trapping, also called optical tweezers, is a tractor beam in real life that can trap nano/microscale particles without physical contact. Different from most existing optical tweezers that are based on objective lenses and confined in research labs, we use optical fibers to realize small and portable optical trapping systems that can potentially enable new applications in the field. We have experimentally demonstrated the differentiation of human breast cancerous cells from normal ones in the water, with the particle temperature and mass measurements of airborne carbon particles underway, indicating the potential applications in early-stage cancer diagnosis, environmental monitoring, and manufacturing process monitoring.

22. Xin Tian

A Heterogeneous Non-Overlapping Domain Decomposition Explicit Finite Volume Method for Real-Time Estimation of 3D Advection-Diffusion Fields with a Sensing Aerial Vehicle

Department: Aerospace Engineering

Advisor: Nikolaos Gatsonis

Degree Level: Ph.D.

Keywords: Non-overlapping domain decomposition, Hybrid estimator, Real-time estimation, Advection-diffusion equation, Finite volume method

Description: A hybrid estimator is developed by using heterogeneous non-overlapping domain decomposition method. The developed estimator can be used to track a stationary or moving gaseous source and meanwhile estimate the concentration profile.

23. Gabriel Torres

Performance Based Guidance for Underwater Automous Vehicles

Department: Mechanical Engineering

Advisor: Michael Torres

Degree Level: Master's

Keywords: Dynamics, Underwater, Tracking, control, Guidance

Description: Underwater autonomous vehicles (UUAVs) for survey and sensing applications. This work develops a control strategy for UUAVs for concentration source tracking such that vehicle is able to map the studied concentration field and its boundaries within a given fluidic domain.

24. John Trainor

Microgravity Combustion Experiment

Department: Aerospace Engineering

Advisor: Jagannath Jayachandran

Degree Level: Master's

Keywords: Combustion, Refrigerants, Microgravity, Compact Design

Description: The goal of this experiment is to create microgravity conditions in a lab to measure flame speeds. Large drop towers provide several seconds of microgravity at the expense of being very large, costly, and permanent structures. Our experiment will be compact enough to fit in a lab, while providing 0.5 seconds of microgravity for necessary measurements.

26. Shuai Wang

A Novel Enzyme catalyze solid material

Department: Civil Engineering

Advisor: Nima Rahbar

Degree Level: Ph.D.

Keywords: carbonic anhydrase, biomineralization, gelatin, selfhealing

Description: We applying biomineralization technology -- enzyme catalyst to develop new a material with fast growth and stiff.

27. Chao Wang

effect of physical environments on driving performance and behaviors

Department: Environmental Engineering

Advisor: Shichao Liu

Degree Level: Ph.D.

Keywords: biological signal, driving performance test, vehicle cabin environment

Description: This research aims to investigate how the air quality in an automobile and their effects on driving performance. Statistical analysis is applied to investigate the influence of physical environments on driving behaviors. The instant vehicle information, biological signal, and environmental quality are fed to a neural network for training algorithm and driving behavior prediction.

28. Yi Jie Wu

Magnesium hydride as a sustainable aerospace fuel

Department: Chemical Engineering (Professional MS)

Advisor: Jagannath Jayachandran

Degree Level: Master's

Keywords: aerospace, fuel, sustainable, equilibrium, magnesium

Description: The presentation describes the potential of magnesium hydride slurry as a aerospace fuel and will demonstrate its use compared to a surrogate fuel. Models that can visualize the behavior of the slurry during combustion at certain engine conditions are shown.

29. Zhiying Xiao

a novel thermo-optical PCM film system for building enclosures

Department: Civil Engineering

Advisor: Mingjiang Tao

Degree Level: Ph.D.

Keywords: Phase change materials, Transparency shift, building energy

Description: In order to save energy for heating and cooling, a novel thermo-optical based solid-solid phase change material (SS-PCM) film system is developed to take advantage of solar radiation.

30. Yash Yadati

Automatic Generation of System Diagrams from Bond Graphs

Department: Mechanical Engineering

Advisor: Pradeep Radhakrishnan

Degree Level: Master's

Keywords: Collision Detection, Grammar Rules, Optimization Algorithms, CAD

Description: The goal of this research is to create an educational tool that automatically generates system diagrams from bond graphs by using a rule-based approach alongside optimization algorithms. In the process, a software platform is being developed that will assess a user input and provide a form of automated grading and contextually correct feedback.

31. Mengqiao Yang

Enhancement of Drying Rate of Moist Porous Media with Electric Field

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Ph.D.

Keywords: Drying, Electric field, Evaporation, Energy efficient

Description: Drying of moist porous media, such as food or pulp and paper, is an energy-intensive process. In this presentation, a new drying technology making use of the Dielectrophoresis (DEP) mechanism is introduced to enhance the drying process of a moist porous medium. An experimental setup is built up and the corresponding experimental tests are performed. The results show a significant impact of the DEP force on the temperature profile and drying rate of the sample. The experimental work provides a basic understanding of this novel technology to enhance the drying process in various industry sectors, such as forest products, food, pharmaceuticals, and chemicals.

32. Songge Yang

A novel hybrid high-throughput CALPHAD/DFT model for the design of Al-Co-Cr-Fe-Ni High entropy alloys (HEAs)

Department: Materials Science & Engineering

Advisor: Yu Zhong

Degree Level: Ph.D.

Keywords: High entropy alloy, high-throughput, CALPHAD, DFT

Description: High entropy alloys are considered as promising metallic alloys used for structural and high-temperature applications. However, the investigation of mechanical properties with full compositions range could be challenging purely based on the trial-and-error approach. This current work developed a hybrid computational modeling approach, which significantly reduces the cost for the developments of next-generation HEAs

33. Mengxuan Zhao

The Effects of Filling Solutions on Chemical Volume Change of Metakaolin-based Geopolymers

Department: Civil Engineering

Advisor: Mingjiang Tao

Degree Level: Ph.D.

Keywords: chemical volume change, Geopolymers, FTIR, SEM, BET

Description: The effects of filling solutions on chemical volume change of matakaolin-based geopolymers (MKGs) were examined in this study with taking Activator solution (AS) and Deionized water (DIW) as the filling solutions. Chemical volume change of MKGs with two filling solutions were evaluated. The changes in pH values, Na and Al concentrations in filling solutions of each sample cured at elapsed time were examined by pH meter and ICP Mass Spectrometer. The heat release of the reaction with three groups were evaluated by Isothermal Conduction Calorimeter. The morphology, chemical ratios, chemical bonding, and pore information of surface, middle, and bottom part of control, AS, and DIW solid samples cured at elapsed time were characterized by Scanning Electron Microscopy, Energy Dispersive X-Ray, Fourier-transform infrared spectroscopy, and Brunauer-Emmett-Teller, respectively, to better understand the feasibility of different filling solutions. AS group maintained high pH values all the time, extracted dramatically number of Al ions from geopolymer paste, and has relatively lower main band wavenumber, high Si/Al molar ratios and high Na/Al molar ratios, suggesting the higher geopolymerization degrees in the system. ICC results show that the adding of activator solution as the filling solution will cause further reactions, while the adding of DIW as the filling solution will cause the stop of the reactions. Although the surface part of DIW samples show lower geopolymerization degree, the total pore volume is not influenced that much compared to the control group, while the AS group has much smaller total pore volume, which is a critical factor in measuring the chemical volume change of MKGs. This is a good evidence that DIW is more proper to be the filling solution in chemical volume change test of MKGs.

34. Xingtong Guo

Are LEED-certified apartments more satisfying? What do tenants say?

Department: Civil Engineering

Advisor: Shichao Liu

Degree Level: Ph.D

Keywords: LEED-Certified apartments, post-occupancy, satisfaction, topic modelling, sentiment analysis

Business and Social Science

35. Fadi Almazyad

Social Media and Digital Activism, Affordance perspective

Department: Information Technology

Advisor: Eleanor Loiacono

Degree Level: Ph.D.

Keywords: Social Media, Digital Activism, Social Movements, Affordance

Description: Social media has changed how people interact and behave in cyberspace. The research is using the affordance theory to understand how social media empowered social movements and digital activism.

36. Moayad Alshawmar

What do wellness mHealth apps afford users?

Department: Business Administration

Advisor: Bengisu Tulu

Degree Level: Ph.D.

Keywords: mHealth applications, wellness mHealth apps, mobile health apps, affordance theory, grounded theory

Description: Wellness mHealth apps promote physical activity, better sleep, weight loss, etc., and have the potential to improve users well-being. Using Affordance Theory, this study uncovers what these apps afford users, an unanswered question, and how these affordances help users to reach their goals and improve their well-being. We conducted interviews with users and collected app store reviews to answer our research question.

37. Hector Boye

Digging Ourselves Out of Corruption. Is it Feasible?

Department: Science and Technology for Innovation in Global Development

Advisor: Robert Krueger

Degree Level: Ph.D.

Keywords: Ghana, Corruption, Ethics, Values

Description: Any corruption associated with a built-environment infrastructure project in a society entrenched in corruption is analogous to an invisible crack in that building block of development. This paper addresses the major factors leading to corruption in Ghana and their social, economic and political impacts and recommends approaches to mitigate these impacts.

38. Kennedy Damoah

The Need to Survive: How Students Understand Natural Selection.

Department: Social Science & Policy Studies

Advisor: Neil Heffernan

Degree Level: Masters

Keywords: Evolution, Natural Selection, and Intuitions

Description: The theory of evolution is misunderstood by many students. Some have attributed it to religious tendencies, political affiliations, and cultural reasons. This project argues that Natural Selection, the mechanism of evolution, is counterintuitive.

39. Kathryn Drzewiecki

What Teachers Don't Know Can't Help Them: Identifying Evidence-Based Metrics for Learning

Department: Learning Sciences & Technologies

Advisor: Erin Ottmar

Degree Level: Master's

Keywords: Educational technology, Mathematics education, Data visualization

Description: When students use educational technologies there is a lot of data that is collected about when, how, and what students are doing while using the program, however, not a lot of research has been conducted on how to best get that data to teachers in a usable way. This research aims to investigate that data and figure out what metrics best predict learning.

40. Avery Harrison Closser

Monkey See or Monkey Do? The Effects of Worked Example Presentations on Student Learning

Department: Learning Sciences & Technologies

Advisor: Erin Ottmar

Degree Level: Ph.D.

Keywords: online learning, worked examples, algebra, embodied cognition

Description: With online learning becoming increasingly central to K-12 education, it is critical to provide effective instructional support for students in online learning environments. Worked examples, or step-by-step solutions to a given problem, are an effective type of instructional support; however, little research has explored how different presentations of worked examples may impact student learning in online environments. This project examines the impact of 1) self-explanation prompts and 2) student action in worked examples on student learning to provide recommendations for online learning technologies.

41. Haadi Mombini

Machine Learning-based Explanation Facility for Chronic Wound Management

Department: Business Administration

Advisor: Bengisu Tulu

Degree Level: Ph.D.

Keywords: Chronic wounds, Interpretable machine learning, Prediction explanations, Actionable care decisions, Decision support systems

Description: Each year chronic wounds affect 6.5 million Americans and cost $28-$32 billion. Clinical guidelines provide non-specialist care providers (visiting, community and registered nurses) narrative explanations and generalized recommendations to treat wound patients, but their use is limited for personalized and actionable wound care decisions in remote areas. This study proposes a wound care decision support solution that uses (a) machine learning (ML) to predict care decisions based on wound images taken using a smartphone camera and (b) explanation techniques to interpret predictions.

42. Vy Ngo

Exploring the Relationships between Gender, Teachers' Perception, and Students' Performance and Attitudes in Math

Department: Learning Sciences & Technologies

Advisor: Erin Ottmar

Degree Level: Master's

Keywords: Teachers' Perception, Gender Gaps, STEM, Math, Correlational Study

Description: I will investigate whether teachers' perception of their students affects students' math performance, as well as students' engagement, interest, and self-confidence in the subject during middle school - a time period when students' attitude towards STEM is being solidified. Further, I will explore whether students' gender affect these relationships.

43. Luisa Perez Lacera

The Effects of Operand Position and Superfluous Brackets on Student Perforamance in Algebra Problem-Solving

Department: Social Science

Advisor: Erin Ottmar

Degree Level: MS

Keywords: Brackets, Mathematics, Order of Operation, Perceptual Cues

Description: This study explores the effects of the presence and position of superfluous brackets within mathematical experessions on student performance. Using an online learning platform, students will solve order of operation expressions that will record their average response time and mastery speed.

44. Hannah Smith

Thinking Computationally: What it means and how to measure it

Department: Learning Sciences & Technologies

Advisor: Erin Ottmar

Degree Level: Ph.D.

Keywords: Computational Thinking, Educational Games, Game Design, Mathematics Education

Description: Researchers have struggled to come up with an agreed upon definition of Computational Thinking. In this poster I will present ongoing work to define Computational Thinking in the context of a game play and design framework where students play, create and program technology-based math games. Further, I will go over how we aim to assess Computational Thinking in this context.

45. Lidan Zhang

A review of smartphone interventions for post incarceration

Department: Information Technology

Advisor: Bengisu Tulu

Degree Level: Ph.D.

Keywords: Post-incarceration, Smartphone, Substance Use Disorder, Intervention, Mobile app

Description: In the US, up to 90% of incarcerated individuals have substance use disorder (SUD) or mental health disorders, but programs and services to help them with their reentry are scarce. Since smartphones are widely available, utilizing digital health technology as a support tool to equip justice-involved individuals is increasingly prevailing. The purpose of this study is to review smartphone interventions that help justice-involved individuals with SUD and their reentry into communities.

46. Shimi Zhou

Smart Cities for All

Department: Business Administration

Advisor: Eleanor Loiacono

Degree Level: Ph.D.

Keywords: Smart Cities, People with Disabilities, Quadruple Helix Model

Description: 1. Smart cities are promising communities that use intelligent and smart technologies to connect citizens through the Internet in order to improve their quality of life. 2. Smart technologies are especially important for citizens with disabilities, who often face great difficulties in day-to-day living. 3. In order to better understand how smart city research is addressing the needs of people with disabilities, we employ the Quadruple Helix Model to categorize and highlight the stakeholders (citizens, government, universities, and industry) and what areas have received the most research to date.

Chemical Engineering and Materials Science

47. Cameron Armstrong

Reactor Dynamics: Thermal Oscillations and Catalytic Enhancements

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Ph.D.

Keywords: Catalysis, Dynamics, Microreactor

Description: Reactions over heterogeneous catalysts have been studied for centuries, but their kinetic rates have always been constrained due to thermodynamically induced maxima. Reaction dynamics introduces an alternative to the traditionally static reactions and potentially unlock exciting new catalytic pathways which lead to massive rate enhancements. A microreactor system was constructed capable of inducing thermal oscillations on the order of catalytic turnover to observe these rate enhancements.

48. Meshack A Audu

High temperature electrolysis of water for hydrogen production and simultaneous reduction of HTL aqueous phase organics

Department: Chemical Engineering

Advisor: Mike Timko

Degree Level: Ph.D.

Keywords: Electrolysis, HTL aqueous phase, organics reduction, Thermodynamics analysis

Description: Hydrothermal liquefaction (HTL) is a process whereby water at high temperature and pressure converts biomass into biofuel. The wastewater derived from this process is usually plagued with organic matter ((N- or O-containing hydrocarbons). This poster will enlighten the audience on the possibility of using electrochemical methods for removing the organics from the wastewater in the form of light fuels (i.e methane, ethane, etc).

49. Elizabeth Belden

Shipboard conversion of plastics to fuel for self-powered ocean cleanup

Department: Chemical Engineering

Advisor: Michael Timko

Degree Level: Ph.D.

Keywords: Marine Plastic, Thermodynamics, Probabilistic Analysis, Waste Fuels

Description: My poster shows a two part study about the feasibility of using shipborne hydrothermal liquefaction to convert ocean plastics into marine fuels. The first part of the study aims to understand the thermodynamic feasibility of such a project. The second part studies the implications of such a system in terms of how long it would take to clean the ocean using such a process.

50. Jacob Crislip

Isolating the role of heat transfer in sol-gel synthesis of LTA by microdroplet crystallization

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Ph.D.

Keywords: Zeolites, Reactive Crystallization, Heat Transfer, Microfluidics, Intrinsic Kinetics

Description: Are observed crystallization rates the result of slow transport or intrinsic kinetics? Zeolite crystallization in microdroplets answers this question by strategically tuning heat and mass transfer rates. Impacts on nucleation and growth are measured using kinetic models and particle size distributions.

51. Fatou Baka Diop

Transitioning Pharmaceutical Industry Perspectives from Batch to Continuous

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Ph.D.

Keywords: Flow chemistry, Training, Pharmaceuticals, Process Intensification, Intensification

Description: This project aims to develop a laboratory course on the conversion from batch to continuous flow process. In the course, the fundamentals of flow chemistry for pharmaceutical applications are highlighted for process chemists, engineers, and students. From this poster, you will get a detailed overview of the training course and the current progress on lab testing.

52. Christian Faria

High-Efficiency High Power Density Direct Carbon Fuel Cell

Department: Materials Science & Engineering

Advisor: Adam Powell

Degree Level: Master's

Keywords: direct carbon fuel cell, solid oxide fuel cell, CALPHAD

Description: This talk will present a novel power generation device which harnesses energy produced by the chemical reaction of carbon with oxygen. It will cover forecasted thermal and electrical performance obtained by computer modeling, as well as experimental results from a proof of concept apparatus. Anticipated cost, efficiency, and net emissions of this device will be compared to conventional methods of power generation.

53. Jinzhao Fu

Zr Doped Lithium Indium Chloride with High Ionic Conductivity for Next Generation All Solid State Battery

Department: Materials Science & Engineering

Advisor: Yan Wang

Degree Level: Ph.D.

Keywords: Solid State Electrolyte, High Ionic Conductivity, All Solid State Battery

Description: All-solid-state battery is one of the most promising technology for the next generation battery. It will not only improve the energy density of batteries but also be able to make the battery safer. Our Zr doped lithium indium chloride can provide a high ionic conductivity which is suitable to work as the electrolyte in an all solid-state battery.

54. Lily Gaudreau

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

Department: Chemical Engineering

Advisor: Elizabeth Stewart

Degree Level: Ph.D.

Keywords: Biofilms, Staphylococci, Microfluidics, Infection Model, in vitro

Description: Four out of every 1000 ICU central venous catheter insertions results in a bloodstream infection, and most are the result of a biofilm forming on the surface of the medical device. In this study, our goal is to develop an in vitro infection-on-a-chip model, which will subject a co-culture of staphylococcal biofilms and tissue cells to growth conditions similar to those experienced by a bacteria biofilm formed on a catheter within a blood vessel in a patient. This model will provide a platform for studying the bacteria-host cell interface and serve as a tool to assess the effectiveness of novel antimicrobials in the prevention and treatment of biofilm forming infections.

55. Jack Grubbs

Understanding the Effects of Repeated Environmental Exposure on Powder Properties for Additive Manufacturing Applications

Department: Materials Science & Engineering

Advisor: Danielle Cote

Degree Level: Ph.D.

Keywords: Powder, Powder handling, Flowability, Moisture content, Additive manufacturing

Description: Metal powder-based additive manufacturing (AM) requires adequate control of powder properties, such as flowability and moisture content, to obtain successful material processing. However, frequently during handling, the metallic powder is repeatedly exposed to ambient conditions, potentially degrading the powder's properties. This study aims to investigate the effects of repeated environmental exposure on the flowability and moisture content of pure Ta and Al 5056 powder for applications in AM.

56. Wenxu Han

Synergistic effects of antimicrobial peptides and antibiotics against Pseudomonas aeruginosa

Department: Chemical Engineering

Advisor: Terri Camesano

Degree Level: Ph.D.

Keywords: antimicrobial peptide, antibiotics, drug synergy

Description: AMP-antibiotic combinations are considered as potential and promising treatments for P. aeruginosa infections because AMP-antibiotic combinations can extend the lifespan of antibiotics, which is vital before new drugs are developed. Besides, AMP-antibiotic combination strategy is also seen as less possible to promote the drug resistance, which is important for slowing the development of bacterial resistance.

57. Jiahui Hou

Lithium Recovery

Department: Materials Science & Engineering

Advisor: Yan Wang

Degree Level: Ph.D.

Keywords: Cathode material recycle, Lithium recovery, Cathode regeneration, Environment friendly

Description: With the rapid development of lithium-ion batteries (LIB), selective recovery of lithium and other valuable metals from spent LIBs is in urgent need because of the shortage of Li and valuable metals and the toxicity of the components. This project focus on the leaching method that can cause selective recovery of lithium from NMC cathode materials, and collect all materials (reactant and production) in the leaching system. This project may create an environmentally friendly and effective recycling approach for battery recycling.

58. Steven Jacek

Co-fired Cathode-Electrolyte Structures for Direct Carbon Fuel Cells

Department: Materials Science & Engineering

Advisor: Adam Powell

Degree Level: Master's

Keywords: Fuel cell, ceramics, processing, sustainable, energy

Description: This presentation will address work towards developing a cathode-electrolyte-charge collector structure with ceramic support for use in a liquid anode direct carbon fuel cell. The proposed technique involves slip casting of the support, followed by coating of the cathode, electrolyte, and charge carrier layers, followed by co-firing to form a dense structure. We anticipate that this work will lead to new records in energy density and longevity of direct carbon fuel cells.

59. David Kenney

Harnessing the Power of Waste by Recovering Oil from Hydrothermal Liquefaction Wastewater through Continuous Solvent Extraction

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Ph.D.

Keywords: Renewable Energy, Continuous Separations, Biofuels

Description: Using hydrothermal liquefaction, our group has proven that municipal wastes can be converted to renewable biofuels which are compatible with today’s industries. Along with the produced biofuels, there is an aqueous phase which wastes a tremendous amount - 15% - of the feed carbon. By using efficient and continuous solvent extraction, we maximize our bio-oil yield, enabling a more sustainable, greener local energy landscape.

60. Heather LeClerc

Understanding the fate of nitrogen in hydrothermal liquefaction

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Ph.D.

Keywords: biomass, energy, waste, bio-oil

Description: The prevalence of waste in society is a detrimental issue to our future along with current world reliance on fossil fuels. In order to combat both of these problems, I propose valorizing waste feeds into bio-oil using hydrothermal liquefaction. Due to the high presence of nitrogen and oxygen in wastes, it is important to work to understand how to tune the fate of these molecules to reduce the need for costly upgrading.

61. Esai Lopez

Modeling the dissociation of CO2 in water in a 2D particle laden flow for water treatment

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Ph.D.

Keywords: Water Treatment, Separation, Colloidal, Modeling, Fluid Flow

Description: The goal of this project is to develop a carbon dioxide driven membrane-less water purification system. The disassociation of carbon dioxide through water was modeled to understand how hydrogen ion and pH gradients form over a diffusion length. Applications of the model are for understanding how water- particle separation can be achieved using diffusiophoresis. Diffusiophoresis is the migration of particles induced by a concentration gradient.

62. Xiaotu Ma

High-performance single-crystal LiNi1/3Mn1/3Co1/3O2 synthesized from a universal etching method

Department: Materials Science & Engineering

Advisor: Yan Wang

Degree Level: Post Doctoral Fellow

Keywords: single-crystal cathode, acid-etching method, ternary cathode materials

Description: Certain challenges, especially the stability and safety concerns caused by the degradation of polycrystalline cathode (PC) materials during cycling, have restricted their applications. One strategy to overcome the limitation of these materials is to replace PC with high-performance single-crystal cathode (SC) materials. Here, a universal etching approach is firstly developed to synthesize SC materials.

63. Christopher Massar

Implementation and Optimization of Blended Morphologies for Coldspray Additive Manufacturing

Department: Materials Science & Engineering

Advisor: Christopher Massar

Degree Level: Master's

Keywords: PSD, Cold Spray, Morphology, Powder, Blending

Description: Understanding the critical velocities of powder based on their morphology is investigated in a manner to optimize the deposition efficiency of blended materials for cold spray additive manufacturing. Thermokinetic modeling will be implemented to help understand how powders can be manipulated to determine the necessary critical velocities for powder blending.

64. Yuhan Mei

Simulating Electrochemical Environments at Metal-Liquid Interfaces

Department: Chemical Engineering

Advisor: Aaron Deskins

Degree Level: Ph.D.

Keywords: DFT, Direct ethanol fuel cells, Catalysis, Electric field, Solvation

Description: This is a computational work on simulating the fuel cell reactions under electric and solvent environments. The research aims to find the optimal conditions to improve the efficiency of direct ethanol fuel cells to produce electricity.

65. Patryck Michalik

Correlating Staphylococcus epidermidis Biofilm pH Gradients with Local Biofilm Mechanical Properties

Department: Chemical Engineering

Advisor: Elizabeth Stewart

Degree Level: Ph.D.

Keywords: Biofilms, Microrheology, pH Gradients, Biofilm Lifecycle, Biofilm Disassembly

Description: Staphylococcus epidermidis frequently causes hospital related and medical device infections, placing a heavy burden on our medical system. Here we assess the relationship between local pH and mechanical properties in Staphylococcus epidermidis biofilms to mechanistically understand how these biofilms breakdown. This study will inform the development of matrix targeted biofilm control strategies which will reduce biofilm infection rates.

66. Bryer Sousa

Antiviral and Antibacterial Copper Coatings for Rapidly Self-sanitizing Antimicrobial Surfaces for a Post-SARS Pandemic World

Department: Materials Science & Engineering

Advisor: Danielle Cote

Degree Level: Ph.D.

Keywords: cold gas-dynamic spray, antipathogenic materials, copper contact killing/inactivation, nanostructured materials, grain boundary diffusion

Description: The solid-state materials consolidation process known as cold spray was successfully utilized for the procurement of anti-pathogenic surfaces and coatings, which can be implemented into hospital environments to mitigate the transmission of viruses and infectious microbes through person-to-surface contact/touching. To enable further research and development of this promising technological approach to mitigating the concentration of disease transmission vectors and routes in medical settings, characterization of the Cu cold spray processed antimicrobial surfaces is presented during this GRIE presentation to better understand what material properties are most responsible for the respective coatings remarkable performance and rate of self-sanitation.

67. Richard Valente

Additive Manufacturing Powder Flowability Prediction using Sequential Auto-Encoders and Tableau

Department: Data Science

Advisor: Rodica Neamtu

Degree Level: Master's

Keywords: flowability, data generation, auto encoders, tableau, sequential auto-encoders

Description: This research focuses on predicting the flowability of powders used in cold-spray additive manufacturing processes, using machine learning. In this presentation we showcase a tool involving virtual dataset expansion, live tableau visualization and sequential auto-encoders. This tool can be used to quickly predict the flowability of novel powders and give insights on powder characteristics to material scientists.

68. Panawan Vanaphuti

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

Department: Materials Science & Engineering

Advisor: Yan Wang

Degree Level: Ph.D.

Keywords: Layered Oxide Cathode, Lithium-ion Batteries, Crystal Lattice Doping, Energy Storage,

Description: Regardless of the successful commercialization of Lithium-ion cathodes used in electronic devices and electric vehicles nowadays, researchers are focusing on higher energy cathode materials than conventional ones to meet the ever-increasing market demands in which Lithium-Manganese-rich layered oxide cathode (LMR) is of great interest due to its high energy density and low cost. This presentation will mainly focus on improving the performance of LMR via doping impurity ions into its crystal structure. The experimental procedures, material characterizations and electrochemical results will be presented.

69. Rui Wang

Computationally guided design of MULTIPLE impurities tolerant electrode

Department: Mechanical Engineering

Advisor: Yu Zhong

Degree Level: Ph. D.

Keywords: Solid Oxide Fuel Cells, CALPHAD, multiple impurities

Description: On purpose of studying the multiple impurities poisoning phenomena in the SOFC cathode systems, three common cathode materials were prepared, sintered and finally annealed in the different impurity-containing atmosphere, respectively. Comprehensive comparisons between the simulation results as well as the experimental verifications under different impurity-containing conditions were also made to provide guidance on the alternatives of the cathode materials.

70. 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, Collagen, Antimicrobial peptides

Description: Recent work from our lab has demonstrated that collagen binding of antimicrobial peptides (AMPs) using collagen binding domains (CBDs) has potential in delivering novel, non-cytotoxic, antimicrobial, and pro-healing therapies to chronic wounds and will not promote bacterial resistance. The goal of this project is to study collagen film deposition as AMPs delivery platform, to quantify CBD-LL37 binding, and to understand the mechanism of CBD-mediated LL37 binding to collagen films.

71. Ziyang Zhang

Salt promoted hydrolysis of cellulose: an experimental and computational analysis

Department: Chemical Engineering

Advisor: Michael Timko

Degree Level: Ph.D.

Keywords: Renewable energy, Biomass decomposition, Salt, Cellulose crystallinity, molecular dynamics

Description: Converting cellulose into glucose is important towards biomass-based renewable energy technology development. In this study, we investigate the effect of salts such as guanidine hydrochloride, calcium chloride, etc. on the hydrolysis of cellulose under mild acid conditions. Further molecular dynamics is used to elucidate the role of cations interacting with cellulose.

72. Yifan Zhang

First-principles molecular dynamics study of molten salt CaF2

Department: Material Science and Engineering

Advisor: Yu Zhong

Degree Level: Ph.D

Keywords: molecular dynamics, molten salt, DFT, CaF2

Description: The CaF2 slag was studied through first-principle molecular dynamics method at high temperature. Several transport properties that people are interested in molten salt were evaluated and compared with experimental data such as self-diffusion coefficient, viscosity, and ionic conductivity.

73. Yadong Zheng

Systematic Study of Al Impurity for NCM622 Cathode Materials

Department: Mechanical Engineering

Advisor: Yan Wang

Degree Level: Ph.D.

Keywords: lithium-ion batteries, hydrometallurgical recycling, NCM622 cathode, aluminum impurity,

Description: For all the battery recycling methods, impurities are always introduced from the current collectors or casing materials, especially aluminum (Al), which might lead to negative effects on recovered electrode materials. Therefore, it is significant to determine the impacts of Al impurity on recovered cathodes. Here, the influence of the Al impurity for the synthesized LiNi0.6Co0.2Mn0.2O2 (NCM622) precursor and cathode is systematically studied.

Data Science, Cybersecurity, and Computer Science

74. Noura Alghamdi

ChainLink: Indexing Big Time Series Data For Long Subsequence Matching

Department: Computer Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Indexing, Time Series, Subsequence Matching, Big Data, Query

Description: ChainLink is a two-layer distributed index over TB-Scale time series datasets. It facilitates the similarity search over long time series objects. Specifically, it supports kNN queries for subsequence queries.

75. Mallak Alkhathlan

Building a Mental Map of the Image to Create Memorable Memories Through Haptic Feedback

Department: Computer Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Haptic, Feedback, tactile, images, vision impairments

Description: Improve applications by adding the features of haptic feedback to know the contents of the image and make it more accessible to the visually impaired users.

76. Aaron Alphonsus

Feedback Recommendation System for Student Problem Solving Action Data

Department: Computer Science

Advisor: Neil Heffernan

Degree Level: Masters

Keywords: Feedback, Human-in-the-loop AI, Recommendation Systems, NLP, Time Series

Description: Computer-based systems have the unique advantage of being able to collect action-by-action reports of how a student reached an answer, the time it took to do so, and a wealth of other data. It is difficult for teachers to analyze data in this level of detail but it presents us with an opportunity to distill information from it. We take on student problem-solving action data so that we can provide teachers with recommendations to give feedback that will help students improve their study habits.

77. Sami Baral

Error Analysis of Automated Grading of Student Open Responses in Mathematics

Department: Computer Science

Advisor: Neil Heffernan

Degree Level: Ph.D.

Keywords: Automated Scoring, QuickComments, Natural Language Processing, Mathematics, Machine Learning

Description: QUICK-Comments is a tool within ASSISTments (mathematics focused online learning platform) that makes the grading of open response questions in mathematics easier. In this research analysis, we explore the machine learning models used by QUICK-Comments to automate the open response grading process, identify scenarios where the model performance can be improved, and explore the factors that contribute to said low model performance. The goal is to use the obtained insights to guide our focus on the next steps towards improving this tool.

78. Zorigtbaatar Chuluundorj

Securing IoT Devices using Smartphone User Interface Information

Department: Computer Science

Advisor: Craig Shue

Degree Level: Ph.D.

Keywords: Residential Network Security, IoT, Graphical User Interface

Description: With the proliferation of Internet-of-Things (IoT) devices in the residential environment, their security has become a concern to defenders and an attractive target to malicious actors. Thus, we present a novel approach that associates the end-user UI activity of a mobile application with IoT device network activity to construct an allow-list of acceptable network activity to secure IoT devices.

79. Geri Dimas

Modeling The United States Defensive Asylum Process

Department: Data Science

Advisor: Andrew Trapp

Degree Level: Ph.D.

Keywords: Data Science, Modeling, Social Good, Immigration

Description: We explore the intricacies of the United States immigration court system, specifically looking at the defensive asylum process. Through the application of data science methodologies, we determine key factors related to the defensive asylum process and create a model to help represent an asylees' journey through this complex system.

80. Apiwat Ditthapron

Speech-based Traumatic Brain Injury (TBI) assessment using deep learning methods with limited labeled data

Department: Computer Science

Advisor: Emmanuel Agu

Degree Level: Master's

Keywords: Traumatic Brain Injury (TBI) assessment, Speech assessment, Deep learning, Smartphones

Description: People afflicted with Traumatic Brain Injury (TBI) experience long-term impairments, which require follow-up assessments or rehospitalization in some cases. To promote recovery, we propose a Deep Neural Network (DNN) system for non-invasive, speech-based assessment of long-term impairments following TBI that runs passively on smartphones with the main focus on a limited data problem that frequently arises in automatic health assessment.

81. Ramesh Doddaiah

XAI for Time Series Data

Department: Data Science

Advisor: Dr. Elke A Rundensteiner

Degree Level: Ph.D.

Keywords: Explainable AI, Time Series, Deep Learning Models, XAI Gradient Methods

Description: Our proposed gradient-based XAI method explains the deep learning model prediction on Time Series Data. We generate a heat map that shows the importance of each time step.

82. John Erickson

What Kind of Tone is That? A Sentiment Analysis of Teacher Feedback

Department: Data Science

Advisor: Neil Heffernan

Degree Level: Ph.D.

Keywords: Sentiment Analysis, Natural Language Processing, Sentence Embeddings, Machine Learning, Deep Learning

Description: This research explores the diversity of teacher feedback within intelligent tutoring systems. Mainly, we perform an exploratory analysis of the sentiment teachers use when providing feedback to students. Additionally, we attempt to develop a predictive model which uses the student answer to predict the level of sentiment a teacher will use when providing feedback.

83. Walter Gerych

Maximizing Subset Accuracy with Incomplete Labels

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: multilabel learning, incomplete labels, semisupervised learning, machine learning, deep learning

Description: Multi-label classification corresponds to the task of predicting multiple targets given a single input (i.e., identifying all of the objects in an image). Unfortunately, the performance of state-of-the-art multi-label classification algorithms suffer when trained on data with incomplete labels (i.e., not every object in the image is labeled during training). We address this challenge by proposing SAIL, a method for training multi-label classifiers given incomplete labels by successfully modeling the correlations between labels.

84. Ahmad Ghasemi

joint hybrid beamforming and dynamic antenna clustering for massive MIMO

Department: Data Science

Advisor: Seyed A. Zekavat

Degree Level: Ph.D.

Keywords: Machine Learning, Bi-clustering, Graph coloring, mmWave

Description: We offer a new approach for antenna clustering and hybrid beamforming applicable to massive MIMO systems. Simultaneous clustering and hybrid beamforming across transmitter (Tx) and receiver (Rx) antennas is an NP-hard problem. To address this issue, first, we propose an antenna clustering that is applied to both Tx and Rx. In this regard, antenna arrays at Tx and Rx are modeled as a Bipartite graph and for the first time, one bi-clustering algorithm, Spectral Co-Clustering algorithm, is applied to achieve simultaneous clustering. Next, singular vectors of subchannels, which are the channels between subantenna arrays of Tx and Rx, are comprised to determine optimal precoders/combiners. Performance evaluations in terms of Tx-Rx data streaming sum-rate demonstrate the effectiveness of the proposed algorithm.

85. Guin Gilman

Efficient Contention-Aware Scheduling Policies for General Purpose GPUs

Department: Computer Science

Advisor: Robert Walls

Degree Level: Ph.D.

Keywords: GPGPUs, scheduling algorithms, systems architecture

Description: Running multiple applications on one GPU concurrently has numerous advantages for deep learning inference server providers in terms of cost efficiency and resource utilization. However, current hardware does not support the efficient scheduling of multiple deep learning training and inference tasks. This work seeks to provide a domain-specific scheduling policy for such use cases which mitigates the effects due to contention while achieving acceptable turnaround time, utilization, and predictability.

86. Cole Granof

TINSL: Tinsl Is Not a Shading Language

Department: Interactive Media & Game Development

Advisor: Charlie Roberts

Degree Level: Master's

Keywords: graphics, programming, art, live performance

Description: We are developing Tinsl, a programming language for creating special effects in 2D and 3D animations. We designed Tinsl to be used in live-coding performances, where programmers create animations by programming them live in front of an audience.

87. Jacob Grycel

Software Fault Attack Evaluation from the Ground Up: How Hardware Faults become Software Security Hiccups.

Department: Electrical & Computer Engineering

Advisor: Patrick Schaumont

Degree Level: Master's

Keywords: Software Vulnerability, Fault Attacks, Clock Glitching, Hardware Simulation

Description: The vulnerability of embedded software to hardware fault attacks is often evaluated by applying simplified, testing-based fault models to software execution analysis. This project improves upon current capabilities by building a fault model from the ground up using hardware-centric fault simulation and applying the possible fault outcomes to software vulnerability analysis. A hardware-backed fault model greatly improves the accuracy of software analysis by providing predictable and realistic software responses to a range of fault injection parameters.

88. Ashish Gurung

Facilitate effective student-teacher interaction by creating heightened teacher awareness of student performance by identifying students requiring attention in Real Time

Department: Computer Science

Advisor: Neil Heffernan

Degree Level: Ph.D.

Keywords: Real time tracking, Student-Teacher interaction, Data Visualization, Intelligent Tutoring System

Description: We are developing a web-based tool LIVE-CHART(Live Interactive Virtual Environment to Create Heightened Awareness and Responsiveness in Teachers). As students work on their synchronous assignment, LIVE-CHART helps teachers track student progress in real-time and identify students requiring immediate attention.

89. Songlin Hou

Learning-Based Bidirectional Illumination Enhancement Network (HDR Wound Image Analysis)

Department: Computer Science

Advisor: Emmanuel O Agu

Degree Level: Master's

Keywords: deep learning, high dynamic range imaging, image fusion, computer vision, wound image analysis

Description: Wound images taken with smartphones usually suffer from over/under-exposed issues. We demonstrate a novel bidirectional network which can address these two issues at once. Inspired by the HDR process, we generate two images (with different exposures) using the network and fuse them into a final image which preserves more texture information than the original one.

91. Rahul Jakhmola

Student Affect - State or Trait

Department: Data Science

Advisor: Neil Heffernan

Degree Level: Ph.D.

Keywords: Affect Detection, Educational Data Mining, Learning Analytics

Description: Deep Learning based detectors can track student affect in online learning systems - that is if students are bored, concentrating, confused or frustrated while solving problems. We aim to analyze if these affect states are student traits or are dependent on other factors.

92. Han Jiang

Does the semantics of a visual scene affect Neural Network's perception?

Department: Data Science

Advisor: Jacob Whitehill

Degree Level: Ph.D.

Keywords: Convolutional Neural Network, Recognition, Object detection, Semantic

Description: When using convolutional neural networks to recognize or detect objects, we find that the visual tasks' results are affected by the semantic relationships among these objects in the same images. Specifically, we trained CNNs to recognize/detect digits within a mathematical equation that may or may not be mathematically correct according to basic arithmetic subtraction. We find evidence that (1) CNNs can learn to generalize non-trivial arithmetic rules just by training on images, and (2) CNNs' accuracy in recognizing/detecting individual digits is affected by the interaction of (a) whether or not the test image shows a correct/random equation and (b) whether the network was trained on correct/random equation images.

94. Nicholas Josselyn

Automated Corrosion Assessment on Image Data Sets using Deep Learning

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Corrosion, Deep Learning, Segmentation, Classification

Description: In this project, we present research in collaboration with material scientists at the Army Research Lab on analyzing experimental data in the form of images of panels treated with different material coatings. This unique experimental image data set contains panels that have been exposed to artificially induced environments in a laboratory setting and are at different stages of corrosion. We have developed a series of innovative deep learning methods effective for both corrosion area segmentation and for the automated assessment of corrosion scores based on domain-specific rating criteria.

95. Jason King

ASSISTments Automatic Reassessment and Relearning System UI Design

Department: Computer Science

Advisor: Neil Heffernan

Degree Level: Master's

Keywords: ASSISTments, User Interface, Data Visualization

Description: ASSISTments is an education tool designed to provide feedback assistance to students and assessment data to teachers. A prominent feature within ASSISTments is the Automatic Reassessment and Relearning System (ARRS), which helps students retain skills be repeatedly re-evaluating them. I am working alongside other students to develop and modernize the ARRS user interface to better visualize the data teachers and students have access to.

96. Aritra Kundu

Game Player Response Times versus Task Dexterity and Decision Complexity

Department: Computer Science

Advisor: Mark Claypool

Degree Level: Master's

Keywords: response time, task dexterity, self rated skill

Description: Game tasks commonly require dexterous actions and varying amounts of decision-making. People that play games may perform better for basic reaction and decision making tasks in comparison to people that do not play games. This paper presents results from two user studies that evaluate the relationship between self-rated gamer ability and reaction time for two tasks: 1) a task with varying decision complexity, and 2) a task with varying dexterity requirements. Analysis of data from over 150 users shows small effects of self-rated gamer ability on task, but substantial effects of the decision parameters (choices) and dexterity parameters (size and distance) on performance.

97. Yunsen Lei

Attackers as Instructors: Using Container Isolation to Reduce Risk and Understand Vulnerabilities

Department: Computer Science

Advisor: Craig Shue

Degree Level: Ph.D.

Keywords: virtualization, container, forensic analysis

Description: We propose Single-Use-Server, which leverage lightweight virtualization technology to host multiple instances of a server application. Each server instance is managed and tailored to serve a single user. We show that this Single-Use design is effective in eliminating attack persistence, propagation and permission misuse. We also demonstrate by fusing and reconstructing logs, our design help localize vulnerabilities associated with security incidents.

98. Zeqian Li

Compositional Embeddings for Multi-Label One-Shot Learning

Department: Computer Science

Advisor: Jacob Whitehill

Degree Level: Ph.D.

Keywords: compositional embedding, one-shot learning, deep learning

Description: This work proposes a innovative method to recognize individual objects in a multi-object image even though they may never be seen by the model before.

99. Yichuan Li

Multi-Source Domain Adaptation with Weak Supervision in Early Fake News

Department: Computer Science

Advisor: Kyumin Lee

Degree Level: Ph.D.

Keywords: Fake News Detection, Data Mining, Social Computing, AI For Social Good

Description: Nowadays, social media provides unrestricted and diverse information access for the audience. However, underneath the disseminated information flows, there is a considerable amount of fake news spreading globally, putting the whole community in danger. To mitigate the bad effects of the fake news, the fake news detection model should identify the fake news at the early stage before it was widely spread. However, the rapidly evolving fake news leaves a great burden for the state-of-the-art fake news detection method, due to limited in-domain annotated instances. To resolve the data-hungry problem for training the fake news detection model in the target domain, we reuse the data from multiple source domains and utilize the weak signals from the target domain. To this end, we propose a multi-source domain adaptation method with weak supervision (MD-WS) for early fake news detection.

100. Yu Liu

Community Cleanup: Incentivizing Network Hygiene via Distributed Attack Reporting

Department: Computer Science

Advisor: Craig Shue

Degree Level: Ph.D.

Keywords: Software-defined networking, Residential network security, Distributed denial-of-service attack

Description: This research designs a protocol that combining SDN techniques with prior work on collaborative DDoS reporting to identify residential network compromises. This combination provides incentives for end-users to deploy the technique, including rapid notification of compromises on their own devices and reduced upstream bandwidth consumption, while incurring minimal performance overheads.

101. Shengmei Liu

The impact of latency on player performance

Department: Computer Science

Advisor: Mark Claypool

Degree Level: Ph.D.

Keywords: latency, human computer interaction, Gaming, Player performance, QoE

Description: The impact of low range latency on player performance and quality of experience.

102. Lei Ma

Gloria: Global Optimal Multi-Query Sharing Aggregation

Department: Computer Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Complex Event Processing, Aggregation, Sequence Pattern

Description: Gloria proposes an online event trend aggregation framework that can support sharing among queries with nested kleene operators. Given a workload and the statistics of the stream, instead of enumerating the all the possible sharing plans, Gloria sets up some prunning rules which reduce the search space from super-exponential to linear effeciently and effectively. The selected sharing plan by Gloria is proved to be global optimal and can lead the sharing aggregation execution in the most efficient way.

104. Christopher Micek

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. Effective moderation of social media platforms represents a plausible ameliorator for this problem. Here we examine the polarization and attitudes of users interacting with political social media communities moderated with a peer-based "digital jury" system versus traditional, top-down supervised moderation.

105. Samuel Ogden

CacheRipper: A Content Delivery Network for Deep Learning Models

Department: Computer Science

Advisor: Tian Guo

Degree Level: Ph.D.

Keywords: Deep Learning, Cloud Computing, Content Delivery Networks, Caching, Artificial Intelligence

Description: The goal of this work is to develop a content delivery network (CDN) for deep learning models. Deep learning models have a number of attributes, such as non-negligible load time, that differentiate them from traditional caching applications. We therefore examine the application of traditional caching policies and develop new policies to account for the unique needs of deep learning models

106. Sarun Paisarnsrisomsuk

Visualizing Feature Development in Neural Networks using t-SNE

Department: Computer Science

Advisor: Carolina Ruiz

Degree Level: Ph.D.

Keywords: Deep Learning, Feature Exatraction, Biomedical Machine Learning

Description: We develop a deep convolutional neural network (CNN) for sleep stage classification that achieves 84.57% accuracy using human sleep EEG and EOG signals, better than human expert inter-scorer agreement. We apply t-SNE dimensionality reduction to visualize the responses of the internal layers of our network. Our results show the improvement in the network’s class differentiation ability with increasing depth.

107. Prathyush Parvatharaju

Neural Time Series Explainer

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Master's

Keywords: Explainable AI, XAI, Timeseries Explanation, Guided Perturbations

Description: Deep neural networks are being used to build autonomous systems that will perceive, learn, decide, and act on their own. However, their decision-making process is opaque and it is difficult to explain to the end-users. Our aim is to address the problem of Explainable AI for deep neural classifiers that take time-series as input and output influential timesteps for the network's decision in classification.

108. Harsh Nilesh Pathak

Non-convex Optimization Using Parameter Continuation Methods for Deep Neural Networks

Department: Data Science

Advisor: Randy Paffenroth

Degree Level: Ph.D.

Keywords: deep learning, curriculum learning, neural network, optimization, bifurcation

Description: We propose a novel training method for deep neural networks based on the ideas from parameter continuation methods and compare them with widely practiced methods such as Stochastic Gradient Descent (SGD), AdaGrad, RMSProp and ADAM. For an unsupervised learning problem, we show our method converges much faster, consistent and generalizes better than other conventional methods.

109. Thanaporn Patikorn

Effectiveness of Crowd-Sourcing On-Demand Assistance from Teachers in Online Learning Platforms

Department: Computer Science

Advisor: Neil Heffernan

Degree Level: Ph.D.

Keywords: crowdsourcing, online learning platform, randomized controlled trials

Description: In many online learning platforms, students are given on-demand assistance such as hints when they struggle on their assignments. In this work, I investigated the effectiveness of such assistance obtained through crowdsourcing using randomized controlled trials and found them to be beneficial to student learning.

110. Joseph Petitti

Appjudicator: Enhancing Android Network Analysis through UI Monitoring

Department: Computer Science

Advisor: Craig Shue

Degree Level: Master's

Keywords: Cybersecurity, Mobile Devices, Malware, Computer Networks

Description: Malware on Android devices is becoming more common, and poses a serious threat in secure corporate environments. We implement a new system that utilizes user interaction context to determine whether network requests from a mobile device are authorized by a legitimate human user or the result of hidden malware.

111. Ethan Prihar

Identifying Struggling Students by Comparing Online tutor Clickstreams

Department: Data Science

Advisor: Neil Heffernan

Degree Level: Ph.D.

Keywords: Anomaly Detection, Online Learning, Tutoring, Remote Learning

Description: Due to the COVID-19 pandemic, many students must now use online learning platforms in conjunction with regular teaching. This change has made it difficult for teachers to check in on students and has exacerbated achievement gaps. This work proposes an easily scalable algorithm to quickly identify struggling students, which can be used to direct teachers to students in need of assistance.

112. Matthew Puentes

PEGASUS: Powerful, Expressive, Graphical Analyzer for the Single Use Server

Department: Computer Science

Advisor: Craig Shue

Degree Level: Master's

Keywords: web development, debugging, incident response, web security, human computer interaction

Description: Modern websites often use complicated and asynchronous backend and frontend technologies, making the debugging process difficult. This is especially bad when websites have security vulnerabilities. This project, named PEGASUS, seeks to help solve that problem by providing a debugging program for websites that use the single-use-server.

113. Anand Ramakrishnan

Harnessing Emotions to Improve Face Recognition

Department: Computer Science

Advisor: Jacob Whitehill

Degree Level: Ph.D.

Keywords: Deep Learning, One Shot Learning, Embedding Spaces, Geometric constraints, Face Recognition

Description: We explore the utility of harnessing auxiliary labels (e.g., facial expression) to impose geometric structure when training embedding models for one-shot learning (e.g., for face verification). We introduce novel geometric constraints on the embedding space learned by a deep model using either manually annotated or automatically detected auxiliary labels. We contrast their performances (AUC) on four different face datasets (CK+, VGGFace-2, Tufts Face, and PubFig). Due to the additional structure encoded in the embedding space, our methods provide a higher verification accuracy (99.7, 86.2, 99.4, and 79.3% with our proposed TL+PDP+FBV loss, versus 97.5, 72.6, 93.1, and 70.5% using a standard Triplet Loss on the four datasets, respectively). The embedding vectors also retain more information about the auxiliary labels than with a standard triplet loss. Our method is implemented purely in terms of the loss function. It does not require any changes to the backbone of the embedding functions.

114. Atifa Sarwar

Machine Learning for Passive Assessment of COVID-19 using Physiological Signs and Smart Wearables

Department: Computer Science

Advisor: Emmanuel Agu

Degree Level: Ph.D.

Keywords: Machine learning, Passive Assessment, Smart Wearables, Physiological Signs

Description: In the current information age, wearable devices' popularity opens new doors to track the physiological signs unobtrusively and uninterruptedly. They come equipped with a range of sensors to record vital signs such as heart rate, interbeat interval, skin temperature, and blood oxygen saturation. These signs deviate significantly from the baseline when infected, making the diagnosis of infectious disease possible. Our research aims to passively assess the infectious diseases, specifically Influenza and COVID-19, through physiological signs using machine learning and smart wearables.

115. Suhas Srinivasan

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

Department: Data Science

Advisor: Dmitry Korkin

Degree Level: Ph.D.

Keywords: Single-cell RNA sequencing, Deep learning, Unsupervised learning, Cancer Heterogeneity, Breast Cancer

Description: The recent emergence of single-cell RNA (scRNA-Seq) sequencing technology has allowed the characterization of heterogeneous cell populations by accurately measuring transcript expression levels in individual cells. Cellular heterogeneity has been observed in cancers, which could help to explain why some cancers do not respond to treatment and could be targets for future therapeutics. Triple-negative breast cancer (TNBC) is known for its high inter- and intra-tumor heterogeneity. TNBC is associated with poor survival prognosis due to its aggressiveness and lack of effective therapies. We design a novel deep unsupervised single-cell clustering method (DUSC) to learn an unbiased and robust representation of the scRNA-Seq data to identify cells in tumors and the relationship to survival rate.

116. Jidapa Thadajarassiri

Semi-Supervised Knowledge Amalgamation for Sequence Classification

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Knowledge Amagamation, Teacher-Student Model, Semi Supervised Method, Sequence Classification

Description: We propose a Teacher Coordinator (TC) to amalgamate the knowledge of multiple pre-trained teacher models into a single student model that becomes an expert over all teacher tasks. Our study emphasizes a setting for sequential data with limited labeling.

117. ML Tlachac

Leveraging Deep Learning to Detect Depression from Text Message Content

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: deep learning, mHealth, depression screening, natural language processing, text messages

Description: While depression is treatable, many people with this debilitating mental illness remain undiagnosed. Thus, passive and instantaneous depression detection is needed. This research explores the ability of state-of-the-art deep learning models to screen for depression from the content of text messages.

118. Jean-Baptiste Truong

Confidential and Private Deep Learning

Department: Computer Science

Advisor: Robert Walls

Degree Level: Master's

Keywords: Cybersecurity, Machine Learning, Privacy, Confidentiality

Description: My work focuses on making machine learning algorithms confidential and private. Confidential, as the algorithm itself holds a great value to the provider. Private, because the end-user may want to maintain their personal data privacy.

119. Joseph Turcotte

Disrupting Attacker Value Propositions in Residential Networks

Department: Computer Science

Advisor: Craig Shue

Degree Level: Master's

Keywords: home networks, cyber deception, software defined networking, router security

Description: Home networks introduce a unique set of security and privacy concerns, including efforts by outside parties to gain unauthorized access to home-networked devices and services. This work focuses on equipping residential routers with tools to deter these efforts and simultaneously preserve access for legitimate users.

120. Peter VanNostrand

Leveraging Labeled Examples for Robust Deep Anomaly Detection

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Anomaly Detection, Outlier Detection, Deep Learning, Semi-Supervised Learning

Description: Anomaly detection, the process of identifying abnormal data samples, is a challenge due to the lack of large-scale labeled datasets. As human data labeling is prohibitively expensive, it is common to have a large, unlabeled dataset consisting of mostly normal data with only a small number of explicitly labeled samples. We propose a method for using these labeled samples as examples to guide the learning of anomaly detection methods and prevent a loss of performance due to unlabeled anomalies present in the training data.

121. Nguyen Vo

Where Are the Facts? Searching for Fact-checked Information to Alleviate the Spread of Fake News

Department: Data Science

Advisor: Kyumin Lee

Degree Level: Ph.D.

Keywords: information retrieval, neural ranking model, multimodal, fact-checking, learning to rank

Description: We propose a novel multimodal neural ranking to search for verified information. Our framework is a novel method to alleviate the spread of fake news.

122. Pitchaya Wiratchotisatian

A Comparative Study of Stability Representations for Solving Many-To-One Matching Problems with Ties and Incomplete Lists via Integer Optimization

Department: Data Science

Advisor: Andrew Trapp

Degree Level: Ph.D.

Keywords: Many-to-One Matching, Stable Allocation, Integer Optimization, Computational Study, Lexicographic Optimization

Description: This project studies integer optimization for many-to-one matching with incomplete lists and ties for matching students to project centers. We introduce several new stability constraint representations that ensures the outcome is envy-free among all students and project centers. Our comprehensive experiments reveal that the computational performance of our stability constraints is more efficient than the existing methods for typical real-world matching applications with enough seats for applicants.

123. Roger Wirkala

Determining Causal Relationships From Historical Analysis of Event Log Data

Department: Computer Science

Advisor: Craig Shue

Degree Level: Master's

Keywords: Next Generation Firewalls, User Intent, Incident Response, Web Application Security

Description: Both web developers and network defenders need to understand the relationship between cause and effect in order to identify vulnerable code and stop attacks. In both scenarios, identifying and leveraging casual relationships are crucial to success. A direct relationship between lines of code and a CVE or a user action and the resulting network activity would enable high confidence decisions to enhance security in both scenarios.

124. Xiaokun Xu

A First Look at the Network Turbulence for Google Stadia Cloud-based Game Streaming

Department: Computer Science

Advisor: Mark Claypool

Degree Level: Ph.D.

Keywords: Measurement, Monitoring and telemetry, Cloud-based, Streaming, QoE/QoS Assurance

Description: While there have been network studies of traditional network games and streaming video, there is less work measuring cloud-based game streaming traffic and none on Google's Stadia. We present experiments that provide a first look, measure Stadia game traffic for several games, analyzing the bitrates, packet sizes and inter-packet times, and comparing the results to other applications. Results indicate Stadia, unlike traditional network game systems, rapidly sends large packets downstream and small packets upstream, similar to but still significantly different than video and at much higher rates than previous cloud-based game systems or video.

125. Kai Yan

Live Coding in Virtual Worlds

Department: Interactive Media & Game Development

Advisor: Charles Roberts

Degree Level: Master's

Keywords: Virtual Reality, Live Coding, Voice Recognition Application, Graphics

Description: Our research examines live coding virtual worlds using specialized virtual reality equipment. We have created an immersive environment where programmers combine voice commands and gesture recognition to create content in a more embodied fashion than traditional programming systems.

126. Biao Yin

Corrosion Domain Adaptation: How to extend lab-based corrosion to real-world corrosion?

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Corrosion, Domain Adaptation, Computer vision, Deep Learning

Description: In this project, we present research in collaboration with material scientists at the Army Research Lab on analyzing experimental data in the form of images of panels treated with different material coatings. This unique experimental image data set contains images subjected to indoor, rapid and artificial laboratory experiments and outdoor, long-scale natural environment experiments. We designed and experimented with domain adaptation methods to answer questions such as: to what extent can indoor corrosion assessment be used to predict outdoor corrosion assessment? These deep learning methods are aimed to accelerate corrosion science exploration.

127. Di You

Quaternion-Based Self-Attentive Long Short-Term User Preference Encoding for Recommendation

Department: Data Science

Advisor: Kyumin Lee

Degree Level: Ph.D.

Keywords: Quaternion-based recommendation, Long-term and short-term user preferences, Quaternion-based attention, Adversarial training

Description: Recent advances prove that Quaternion space has brought several benefits over the traditional Euclidean space. In this work, we fully utilize such advantages and propose two creative modules to study the user's long-term intents and short-term interests, respectively. Experimental results further demonstrate that our proposed model has a strong capability for consistently making accurate recommendations to users.

128. Huayi Zhang

LANCET: Label Complex Data at Scale

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Post Doctoral Fellow

Keywords: Machine learning systems, Active learning, semi-supervised learning

Description: The lack of sufficient labeled data is a common problem facing most real-world machine learning applications â€“ with many popular machine learning models, in particular deep learning models, requiring a huge number of labeled data instances. For human labelers to annotate a large number of data instances is impractical in many cases. In this poster, I describe a labeling system, LANCET, that minimizes the number of human-annotated instances required to generate a high-quality labeled dataset.

129. Dongyu Zhang

Explainable Text Classification With Limited Human Guidance

Department: Data Science

Advisor: Elke Rundensteiner

Degree Level: Ph.D.

Keywords: Explainable Model, Text Classification, Semi-supervised Learning, Natural Language Processing

Description: In many domains, such as healthcare, users prefer the text classification model to explain its prediction. Some recent works generate binary relevant word maps indicating the words that support its prediction. But such models can not generate human-like relevant word maps without huge amounts of human-provided relevant word maps. In this work, we propose a method that can predict classification labels but also extracts relevant word maps similar to human-provided relevant word maps. Our approach can generate human-like explanations given the limited amount of documents in training data are with human-provided relevant words.

130. Yingxue Zhang

Curb-GAN: Conditional Urban Traffic Estimation through Spatio-Temporal Generative Adversarial Networks

Department: Data Science

Advisor: Yanhua Li

Degree Level: Ph.D.

Keywords: generative adversarial networks, self-attention, traffic estimation, spatial-temporal data,

Description: Given an urban development plan and the historical traffic observations over the road network, the Conditional Urban Traffic Estimation problem aims to estimate the resulting traffic status prior to the deployment of the plan. We propose a novel Conditional Urban Traffic Generative Adversarial Network (Curb-GAN), which provides traffic estimations in consecutive time slots based on different (unprecedented) travel demands, thus enables urban planners to accurately evaluate urban plans before deploying them.

131. Xin Zhang

***f*-GAIL: Learning *f*-Divergence for Generative Adversarial Imitation Learning**

Department: Data Science

Advisor: Yanhua Li

Degree Level: Ph.D.

Keywords: Imitation Learning, Generative Models, f-Divergence

Description: Imitation learning (IL) aims to learn a policy from expert demonstrations that minimizes the discrepancy between the learner and expert behaviors. Various imitation learning algorithms have been proposed with different pre-determined divergences to quantify the discrepancy. This naturally gives rise to the following question: Given a set of expert demonstrations, which divergence can recover the expert policy more accurately with higher data efficiency? In this work, we propose f-GAIL, a new generative adversarial imitation learning (GAIL) model, that automatically learns a discrepancy measure from the f-divergence family as well as a policy capable of producing expert-like behaviors. Compared with IL baselines with various predefined divergence measures, f-GAIL learns better policies with higher data efficiency in six physics-based control tasks.

132. Liang Zhang

PARROT: Pattern-Based Correlation Exploitation in Big Partitioned Data Series

Department: Data Science

Advisor: Mohamed Eltabakh

Degree Level: Ph.D.

Keywords: Data Series, Index, Similarity search

Description: We propose a new indexing infrastructure, which primarily builds a novel secondary index capturing the correlation between the partitioning attributes and data series objects. It can efficiently support the kNN similarity search over the data series objects without constructing the traditional expensive primary indexes.

133. Yiyang Zhao

Few-shot Neural Architecture Search

Department: Computer Science

Advisor: Tian Guo

Degree Level: Ph.D.

Keywords: Neural Architecture Search, Auto Mahcine Learning, Artifical Intelligence

Description: With the fast development of deep learning, the neural network becomes the most popular model in different machine learning research areas, e.g. image classification, object detection, and natural language processing. Neural network architectures directly impact the performance of the model for the tasks. Instead of designing the neural network architectures manually based on prior experience, we leverage few super-nets in the search space to automatically design the best neural network architectures, the designed architectures achieve state-of-the-art performance in different machine learning applications, such as image classification, GAN, as well as language processing.

134. Yiqin Zhao

Practical 3D Lighting Estimation for Mobile Augmented Reality

Department: Computer Science

Advisor: Tian Guo

Degree Level: Master's

Keywords: Lighting Estimation, Mobile AR, Computer System

Description: Lighting estimation is an essential task for realistic 3D augmented reality, as the visual coherent between visual and physical world heavily depends on whether the virtual objects are rendered with realistic lighting. In this work, we provide a practical edge-assisted framework to perform spatially variant lighting estimation efficiently.

Life Sciences and Bioengineering

135. Habibeh Ashouri Choshali

The effect of heterogeneity and anisotropy on emergent stress fields in living cells

Department: Civil Engineering

Advisor: Nima Rahbar

Degree Level: Ph.D.

Keywords: living cells, stress field, heterogeneity, anisotropy

Description: Mechanical stress is believed to play an important role on cellular decision in a variety of biological phenomena such as cell fate and proliferation which are a key to many diseases, including cancer. Computational and numerical approaches that aim to quantify stress levels assume homogeneous and isotropic properties while many previous research works have shown heterogeneity and anisotropy in living cells. In this work, using a combined analytical, numerical and experimental approach we aim to study the effect of heterogeneity and anisotropy on predicted stress levels within constrained living cells. Our studies show that the predicted stress field alters significantly if cell layer heterogeneity and anisotropy is considered.

136. Cassandra Brzycki

Epigenetic engineering of Taxus plant cell culture using global DNA demethylating agents

Department: Chemical Engineering

Advisor: Susan Roberts

Degree Level: Ph.D.

Keywords: Plant cell culture, Epigenetics, Gene expression, Metabolic engineering

Description: Paclitaxel is a widely used chemotherapeutic drug industrially produced using Taxus cuspidata plant cell culture. However, yields of paclitaxel are unstable and decrease over time due to increased DNA methylation, limiting the long-term utility of this technology. By engineering DNA methylation using DNA demethylating agents, we have developed a method to increase yields of paclitaxel precursors in Taxus plant cell culture.

137. Elizabeth DiLoreto

Can infection change the brain's wiring?

Department: Biology & Biotechnology

Advisor: Jagan Srinivasan

Degree Level: Ph.D.

Keywords: Caenorhabditis elegans, Infection, Staphylococcus aureus, Neuroimmunology, Gut Microbiome

Description: Staph infection effects a worm's gut but it is unknown how it is first detected in the brain. This project aims to identify what neural mechanisms are involved in first sensing the infection and signalling the body to mount an immune response.

138. Andre Figueroa Milla

Cell-only 3D Bioprinting for Vascular Tissue Engineering

Department: Biomedical Engineering

Advisor: Marsha Rolle

Degree Level: Ph.D.

Keywords: Bioprinting, Tissue Engineering, Vascular, 3D, Patient-specific

Description: My research is focused on improving the way we use tissue engineering to generate human blood vessels in a lab. I am developing a 3D bioprinting method that uses only cells to engineer tissues that simulate blood vessel structure and function. Bioprinting cells only, without a supporting printing material or “bioink”could enable us to create characteristics of living tissues that are unique to patient anatomy and physiology, and better predict how drugs will perform when treating diseases.

139. Alicia Howell-Munson

Investigating similarities between unconscious and self-reported mind wandering in brain data

Department: Bioinformatics & Computational Biology

Advisor: Erin Solovey

Degree Level: Ph.D.

Keywords: brain data, mind wandering, fNIRS, similarity search

Description: Identifying undetected cognitive states is often a difficult process, so we aim to discover similar neurological biomarkers in self-reported data to represent these key states. We used a psychological task that induces mind wandering and asked participants to identify when they noticed their mind wander. Then, through a distanced-based similarity search tool called BrainEx, we compared their self-reported mind wandering events to the events that would indicate undetected mind wandering in the psychological task.

140. Edward Jarvis

Confinement-induced flow patterns in microtubule-based active fluids

Department: Physics

Advisor: Kun-Ta Wu

Degree Level: Ph.D.

Keywords: Complex fluids, Geometric boundary conditions, Uniform temperature convection, Moffat eddies

Description: Boundary conditions influence the outcome of fluid dynamics in conventional passive fluid systems. Such an influence also extends to active fluid systems where fluid can flow by itself without an external driving force. For example, an active fluid that is confined in a thin cylinder can self-organize into a circulation along the central axis of the cylinder but thinning the cylinder to a disk-like geometry suppresses the formation of circulation. These phenomena demonstrated the role of confinement geometry on flow patterns of active fluid. Here, we demonstrate two flow patterns induced by confinement. First, we will show that active fluid can convect within a trapezoidal confinement. Such convection was in a temperature-uniform system, in contrast to Rayleigh-BÃ©nard convection which is induced by a temperature gradient. This result suggested the feasibility of developing convection in a temperature-homogeneous system. Second, we demonstrate a confinement-induced stationary vortex near a corner of confinement whose corner angle is below a critical value. This is similar to conventional Moffatt eddies, except the fluid is internally driven. Our work paves the path to controlling self-organization of active fluid using confinement.

141. Mahvash Jebeli

Apoptosis and calcification in the aortic valve

Department: Biomedical Engineering

Advisor: Kristen Billiar

Degree Level: Ph.D.

Keywords: Apoptosis, cell death, calcification, aortic valve

Description: For the human body to keep itself up and running it constantly produces new cells and removes the dead cells. By now we know that those dead cells on the aortic valve can become the nucleation site for calcium to bind and start calcification. When the valve becomes calcified, it becomes dense and almost rigid and it cannot operate as it should.

142. Claire Joswiak

Assessing the function of hECM scaffolds loaded with modified LL-37 antimicrobial peptide

Department: Biomedical Engineering

Advisor: Marsha Rolle

Degree Level: Ph.D.

Keywords: wound healing, biomaterials, antimicrobial peptide, extracellular matrix, LL-37

Description: The goal of this project is to test the antimicrobial abilities of a novel wound dressing. The dressing is made of lab-grown human extracellular matrix (hECM) that is loaded with a modified form of an antimicrobial peptide (AMP) called LL-37, which is native to human tissues. The activity of the AMP-hECM dressing is tested through both in vitro experiments and in vivo lab animal studies.

143. Dhruv Kool Rajamani

Automating the workflow of a MRI-Guided Robot for stereotactic surgical interventions

Department: Robotics Engineering

Advisor: Gregory Fischer

Degree Level: Master's

Keywords: surgical robotics, mri-compatible, medical image processing

Description: Manual stereotactic surgeries, (applications in tumor ablation, deep brain stimulation) are prone to fatal complications that arise from inaccuracies. The proposed work automates the workflow of a MRI-Guided Robot for stereotactic surgeries to improve the efficacy of surgical interventions and reduce the time taken to perform the operation. Significant contributions include a graphical user interface to visualize the robot's workspace and automated detection of the cranial burr-hole for a robotic probe to enter the skull.

144. Nicole Mattson

Analysis of the Effects of Exoskeleton Therapy in Patients with Spinal Cord Injury

Department: Biomedical Engineering

Advisor: Karen Troy

Degree Level: Master's

Keywords: Biomechanics, Exoskeleton, Spinal Cord Injury, Gait

Description: Patients with spinal cord injuries are at a higher risk of fracture around their knees due to the bone loss that occurs as a result of immobility. By using an exoskeleton, patients are able to walk and apply forces on their lowers limbs, potentially having a positive affect on their bone strength, and thus decreasing the likelihood of a fracture occurring. This research assesses the gait during exoskeleton therapy and the change in bone strength before and after therapy.

145. Caroline Muirhead

Multisensory Integration in C. elegans

Department: Biology & Biotechnology

Advisor: Jagan Srinivasan

Degree Level: Ph.D.

Keywords: Decision-making, C. elegans, Multisensory

Description: Multisensory integration (MSI), the process by which the brain synthesizes competing information, is necessary for all animals to function normally. C. elegans offer a viable model to study the neural networks governing MSI, allowing researchers to elucidate how the brain processes conflicting stimuli.

147. Oleksandr Narykov

Integrative modeling of SARS-COV-2 virion

Department: Computer Science

Advisor: Dmitry Korkin

Degree Level: Ph.D.

Keywords: Molecular Dynamics, Structural Biology, High-Performance Computing, Mesoscale system

Description: The year 2020 brought forth the largest pandemic of the past century, caused by the SARS-CoV-2 virus. Even though a large part of its structural proteins was experimentally resolved, designing efficient antiviral drugs require better understanding of the SARS-CoV-2 surface. We present a physically tractable mesoscale system of viral envelope that amalgamates the most recent information on viral envelope (protein structures, stoichiometry, and geometry) and corresponding molecular dynamics simulations of its behavior in solvent. These results would identify new antiviral drug targets, e.g., membrane proteins, for SARS-COV-2 and provide foundation for studying other Coronaviridae.

148. Julia Ryan

Investigating putative RNA-binding proteins in Mycobacterium smegmatis

Department: Biology & Biotechnology

Advisor: Scarlet Shell

Degree Level: Ph.D.

Keywords: Mycobacterium smegmatis, Mycobacterium tuberculosis, RNA degradation, RNA binding proteins, Small RNA chaperone

Description: Three proteins that may bind either to RNA or to the essential ribonuclease RNAse E have been identified in Mycobacterium smegmatis, a non-infectious relative of the pathogen Mycobacterium tuberculosis. This work explores some of the potential roles these proteins might have in RNA metabolism in M. smegmatis and presents plans for future experiments.

149. 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, Determinants

Description: We applied both unsupervised and supervised machine learning to study the mRNA degradation patterns and their determinants in mycobacteria.

150. Andrew Wilzman

Mechanical risk factors for predicting stress fracture in elite runners

Department: Biomedical Engineering

Advisor: Karen Troy

Degree Level: Ph.D.

Keywords: biomechanics, running, fracture, sports

Description: Bone stress injuries (BSI) are common in elite cross-country runners, and our goal is to find a biomechanical measurement that can predict the future occurrence of a BSI. In forty collegiate runners, foot pressure data were gathered during walking and athletic movements such as running and jumping. These athletes were then followed through their collegiate running career and all BSI incidents were recorded to study the correlations between the data gathered and which of the athletes developed BSIs, and which bones were injured.

152. Ying Zhou

The role of RNase E in mRNA metabolism in Mycobacterium smegmatis

Department: Biology & Biotechnology

Advisor: Scarlet Shell

Degree Level: Ph.D.

Keywords: RNase E, mRNA degradation, Post-transcriptional regulation, RNA degradosome

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

153. Sara Amato

Modeling Microglia Activation and Inflammation-Based Neuroprotectant Strategies During Ischemic Stroke

Department: Applied Mathematics

Advisor: Andrea Arnold

Degree Level: Ph.D.

Keywords: neuroinflammation, ischemic stroke, microglia activation, neuroprotectants, paramater sensitivity

Description: Neural inflammation immediately follows the onset of ischemic stroke. During this process, microglia cells can be activated into two different phenotypes: the M1 phenotype, which can worsen brain injury by producing pro-inflammatory cytokines; or the M2 phenotype, which can aid in long term recovery by producing anti-inflammatory cytokines. In this study, we formulate a nonlinear system of differential equations to model the interactions between microglia and cytokines. Additionally, we explore neuroprotectant-based modeling strategies to suppress the activation of the detrimental M1 phenotype, while promoting activation of the beneficial M2 phenotype.

154. Teagan Bate

Self-organization and mixing of microtubule-kinesin active fluid in an activity gradient

Department: Physics

Advisor: Kun-Ta Wu

Degree Level: Ph.D.

Keywords: microtubule-kinesin active fluid, self-organization, activity gradient, mixing

Description: Active fluid, composed of kinesin-driven extensile bundles of microtubules, consumes ATP locally to create a self-mixing flow. Mean speed of microtubule-kinesin active fluid was shown to be tunable by varying its componentsâ€™ concentrations. Such tunability demonstrated the controllability of active fluid with uniform activity. However, how active fluid self-organizes when its activity is non-uniform remains poorly understood. Here, we characterized active fluid behavior and its associated mixing performance in an activity gradient. The activity gradient was created by imposing a temperature gradient because our previous work showed that microtubule-kinesin active fluid exhibited an Arrhenius response to temperature: Increasing temperature sped up active fluid flow, and thus, along a temperature gradient, active fluid flowed faster on one side and slower on the other, forming an activity gradient. We characterized how such a gradient influenced the mixing performance of active fluid in terms of mixing efficiency, stretching rate, and mean squared displacement, comparing with an activity-uniform sample. Our work suggests that applying an activity gradient can serve as a new in-situ method for controlling self-organization and mixing performance of microtubule-kinesin active fluid.

155. Jiazhang Chen

Investigation of mechanosensation in drosophila larvae: local stimulation and response of mechanosensitive neurons

Department: Physics

Advisor: Qi Wen

Degree Level: Ph.D.

Keywords: mechanosensation, atomic force microscopy, neurobiology, drosophila melanogaster

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

157. Lyric Liu

Bayesian Inference for Big Data: Combining Probability Sample and Non-probability

Department: Statistics

Advisor: Balgobin Nandram

Degree Level: Ph.D.

Keywords: Missing at random, Non-probability sample, Regression modeling, Propensity score, Variance estimation

Description: Big Data often presents as massive non-probability samples (nps). Unlike the probability samples (ps), there are no selection probabilities or weights in the nps. Integrating ps and nps is becoming a very important topic. We will illustrate a model to meet this purpose.

158. Elisa Negrini

System Identification Through Lipschitz Regularized Deep Neural Networks

Department: Applied Mathematics

Advisor: Luca Capogna

Degree Level: Ph.D.

Keywords: Deep Learning, System Identification, Ordinary Differential Equations, Network Regularization, Generalization

Description: In this work we use neural networks to learn governing equations from data. Specifically we reconstruct the right-hand side of a system of ODEs x'(t) = f(t, x(t)) directly from observed uniformly time-sampled data using a neural network. In contrast with other neural network-based approaches to this problem, we add a Lipschitz regularization term to our loss function. In the synthetic examples we show empirically that this regularization results in a smoother approximating function and better generalization properties when compared with non-regularized models, both on trajectory and non-trajectory data, especially in presence of noise.

159. Vuong Truong

Multimodal sub-THz radar and LiDAR imaging for NDE Applications

Department: Physics

Advisor: Douglas Petkie

Degree Level: Ph.D.

Keywords: terahertz imaging, FMCW, LiDAR point cloud, sensor fusion, computer vision

Description: We introduce a sub-THz FMCW radar combined with a LiDAR unit as a multimodal 3D imaging system for non-destructive evaluation applications. The radar imaging system operates near 100 GHz by raster scanning with a motorized confocal mirror, coupled with a 2D LiDAR sensor to capture a 3D point cloud to enable target detection. The LiDAR unit can serve to identify the external features that will provide parameters to optimize the radar performance and to assist in the deconvolution of the obscurant clutter from the target signatures that include image intensity, coherent detection of motion, and micro-Doppler signatures.

160. Megan Varney

Characterizing mixing dynamics and efficiency of microtubule-based active fluids

Department: Physics

Advisor: Kun-Ta Wu

Degree Level: Master's

Keywords: soft matter, active matter, mixing, microtubules

Description: Passive mixing efficiency is related to flow rate and geometry, causing passive mixing to be inefficient or impossible at high viscosities and low volumes. In this project, we investigate active mixing at low Reynolds numbers by characterizing the active mixing efficiency and dynamics of microtubule-based active gels. Characterizing mixing in the low Reynolds number regime is critical for studying fields such as microfluidics, bioassays, and materials synthesis.

Post-Doctoral Fellow

162. Chaozhen Wei

Modeling growth and morphogenesis in single cells and multicellular micro-tissues

Department: Applied Mathematics

Advisor: Min Wu

Degree Level: Post Doctoral Fellow

Keywords: Planar micro-tissue growth, Self-similar tip-cell morphogenesis, differential growth and differential cell stiffness, Neo-Hookean elasticity, Stress relaxation

Description: Understanding the mechanics of growth and morphogenesis in living tissues has been a subject of intense interest but remains an open problem. We develop a continuum mathematical framework to describe the size-and-shape formation of soft biological materials as a result of the coupling between differential growth and the elastic stress field generated by growth. We employ this model to particularly investigate two biological growth processes at different length scales: (1) self-compaction and -extension in multicellular micro-tissue, and (2) self-similar tip growth in single-cell filaments.

163. V Siddartha Yerramilli

EGF stimulation promotes IQGAP1 oligomerization, membrane localization and scaffolding of cytoskeletal proteins

Department: Biochemistry

Advisor: Arne Gericke

Degree Level: Ph.D.

Keywords: Cell signaling, Biophysics, Microscopy

Description: IQGAP1 is a multi-domain protein that acts as a scaffold for multiple signaling pathways including those that generate the production of the lipid messenger PI(3,4,5)P3. This pathway plays a key role in cell mobility processes. Here, we have used live cell imaging to follow the ability of IQGAP to assemble members of the PI(3,4,5)P3 signaling pathway and promote cell mobility during stimulation by epidermal growth factor. In response to EGF stimulation, IQGAP1 oligomerizes, and assembles phosphoinositides with PI3K, PIPKIÎ³ and EGFR to promote PI(3,4,5)P3 production. This response also involves changes in the cellular distribution of both IQGAP1 and EGFR along with clustering of EGFR, and we find that IQGAP1 scaffolds distinct complexes on the plasma membrane as well as on endosomes. Importantly, we directly show that IQGAP1 connects PI(3,4,5)P3-mediated signaling and cytoskeletal signaling pathways by binding PIPKIÎ³ in proximity of the cytoskeletal proteins talin and Cdc42. Overall, our data show that IQGAP1, through its ability to assemble and cluster proteins during stimulation, enhances and prolongs EGFR's signals to initial cytoskeletal reorganization.

Robotics Engineering, Cyberphysical Systems, Electrical and Computer Engineering

164. Fadi Alladkani

Ensemble Learning Methods for Robot Grasping

Department: Robotics Engineering

Advisor: Berk Calli

Degree Level: Ph.D.

Keywords: ensemble learning, neural networks, robot grasping, computer vision, machine learning

Description: There are different expert neural networks used in robot grasping, each with their pros and cons. The ensemble method developed combines them and weights their opinions. The overall performance of the ensemble method provides a superior grasp for the object.

165. Ashay Aswale

Imitating Human Body Motions With Humanoid Robot

Department: Robotics Engineering

Advisor: Michael Gennert

Degree Level: Ph.D.

Keywords: Humanoid Robots, Teleoperation, Whole-body imitation, Atlas Robot

Description: The goal of this research is enable a humanoid robot to learn to perform human tasks by copying an operatorâ€™s motions. We have developed a system that imitates both the upper and lower body motion while keeping the robot stable. Using this architecture, the robot can even walk, stand on one foot, or grab objects by imitating the operator.

166. Yasmina Benkhoui

Pavement crack detection and depth estimation using 3D CNNs

Department: Electrical & Computer Engineering

Advisor: Ludwig Reinhold

Degree Level: Ph.D.

Keywords: Deep learning, computer vision, CNNs

Description: In this research, we explore 3D CNNs and state-of-the-art semantic segmentation techniques for pavement crack delineation and depth estimation.

167. Keshav Bimbraw

Augmented Reality Based Lung Ultrasound Scanning Guidance System for COVID-19 diagnosis

Department: Robotics Engineering

Advisor: Haichong Zhang

Degree Level: Ph.D.

Keywords: Lung Ultrasound, POCUS, COVID-19, Augmented Reality, Coronavirus

Description: Lung ultrasound (LUS) a non-invasive diagnostic exam that produces ultrasound
images of various components of the chest which have been used for diagnosis of respiratory illnesses such as COVID-19. While LUS offers a cost-effective, radiation-free, and portable solution compared with chest X-ray and CT, its accessibility is limited due to its user dependency and the small number of physicians and sonographers who can perform scanning and diagnosis. Because of the need to develop systems that can assist the LUS procedure for diagnosis and monitoring of lung illnesses such as COVID-19, we introduce a framework of guiding LUS scanning with augmented reality in which the LUS procedure can be guided by overlaying the scanning trajectory on an image of the chest.

169. Aatreya Chakravarti

Implantable Cholinergic Neuro Transmitter Monitoring Device with Dual Color Optical Stimulation

Department: Electrical & Computer Engineering

Advisor: Ulkuhan Guler

Degree Level: Master's

Keywords: Acetylcholine Sensing, Cholinergic Neurons, Optical Stimulation, Implantable Device

Description: Neurodegenerative disorders have long been correlated with ion concentrations in the brain. Acetylcholine has been theorized to be a marker of neuronal degeneration, but verifying this theory has not been possible with the current available devices. In this project, our group has focused on designing an implantable device that can record both Ca and ACh ion levels in the brain and transmit collected data wirelessly to an external device.

170. Shreyas Chandra Sekhar

Automating Endoscopic Camera Motion

Department: Robotics Engineering

Advisor: Gregory Fischer

Degree Level: Master's

Keywords: Controls, Medical Robotics, Reinforcement Learning, Augmented Reality, daVinci

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 Surgeonâ€™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.

171. Shou-Shan Chiang

SLInKi: State Lattice based Inverse Kinematics -- A Fast, Accurate, and Flexible IK Solver for Soft Continuum Robot Manipulators

Department: Robotics Engineering

Advisor: Cagdas Onal

Degree Level: Ph.D.

Keywords: Soft Robotics, Continuum Robots, Inverse Kinematics

Description: Soft continuum robots offer unique properties that cannot be achieved using rigid linkage based robot manipulators. However, traditional inverse kinematics solvers are not as effective when being applied to soft continuum robots. Here, we propose a heuristic approach, State Lattice based Inverse Kinematics Solver (SLInKi), which is inspired by concepts originally developed for solving path-finding problems to solve the IK problem of a soft continuum robot. The algorithm implementation is intuitive, runs in real time, and combines the strengths of two algorithms in a unique package that surpasses existing methods in adjustability and efficiency.

172. Alex Chiluisa

A Transluminal Miniaturized Steerable Probe for In-office Laser Surgery of the Vocal Folds

Department: Robotics Engineering

Advisor: Loris Fichera

Degree Level: Ph.D.

Keywords: Medical robots, Continuum robots, Vocal folds, Laser surgery, Office based surgery

Description: The aim of this work is to design, manufacture and experimentally validate a transluminal steerable laser probe to treat benign tumors of the vocal folds. Our work is motivated by the current lack of articulated instrumentation to treat laryngeal tumors in office-based procedures, which makes it challenging to treat tumors located in hard-to-reach areas, for example, below the margin of the vocal folds. We present the preliminary design and construction of our proposed device and demonstrate its ability to amplify a physician’s reach into the larynx.

173. Jesse d'Almeida

Educational Concentric Tube Continuum Robot

Department: Robotics Engineering

Advisor: Jesse d'Almeida

Degree Level: Master's

Keywords: Surgical Robotics, Continuum Robotics, Minimally Invasive Surgery, Educational Robotic Platform

Description: Concentric Tube Robots are a type of robotic manipulator that can move in a snake-like fashion. These robots are becoming increasingly popular in medical (and especially surgical) applications; and yet, they can be incredibly difficult and expensive to build because they are made of special and not always easy-to-source materials, including Nickel-Titanium (NiTi). The goal of this project is to explore the viability of building concentric tube robots with additive-manufactured parts. Success in this research will contribute to make concentric tube robots more widely available.

174. Dhirajsinh Deshmukh

Handheld Force Controlled Ultrasonic Probe through Pneumatic Actuation

Department: Robotics Engineering

Advisor: Haichong Zhang

Degree Level: Master's

Keywords: Pneumatics, Force-control, Ultrasound Probe, Portable, Handheld

Description: We aim to develop a pneumatic actuator based handheld device with a clinical ultrasonic probe to control the force applied on the patient's tissue while performing scans. The main intention behind developing this device was to maximize image quality and exert a minimum amount of pressure on the patient's body for improved comfort and safety.

175. Albert Enyedy

Visual Feedback-Based Arm Motion for Atlas Robot in Simulation

Department: Robotics Engineering

Advisor: Michael Gennert

Degree Level: Ph.D.

Keywords: robotics, humanoid, vision, motion

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 resulting increased calculation speed presents the opportunity for applications such as showing a humanoid robot how to complete a task via mirroring a human participant's motions.

176. Alexander Galvan

Autonomous Grading in Senior Design and Modeling Courses

Department: Robotics Engineering

Advisor: Pradeep Radhakrishnan

Degree Level: Master's

Keywords: Simulation, Design Analysis, Synthesis, 3D printing, Removing 3D printed parts

Description: A program to automatically evaluate student submissions and provide immediate feedback in mechanical engineering design courses is being developed. The project is utilizing concepts related to machine learning and deep learning. Semantic segmentation would allow us to distinguish certain characteristics, which will be followed by a handwriting recognition activity, through the use of TensorFlow, to develop an understanding of the information available in the student submission. The automated recognition will compare the student's work with a given solution that will culminate in the assignment of a grade.

177. Katie Gandomi

Closed Loop Conformal Ultrasound Ablation for Brain Cancer Intervention

Department: Robotics Engineering

Advisor: Gregory Fischer

Degree Level: Ph.D.

Keywords: Interstitial Ultrasound Ablation, Conformal Tumor Ablation, MRI Compatible Surgical Robotics, MR-Thermometry based Feedback, Brain Cancer Interventions

Description: The primary objective of cancer intervention is the selective removal of malignant cells while conserving surrounding healthy tissues. However, achieving appropriate margins can be difficult especially in soft delicate structures such as the brain. In this work, we propose the development of a robot actuated closed loop controller that uses high intensity interstitial ultrasound to closely ablate tumor boundaries using MR-thermometry based feedback.

178. Shang Gao

Real-time Photoacoustic Imaging Laparoscopic for Surgical Guidance

Department: Robotics Engineering

Advisor: Haichong Zhang

Degree Level: Ph.D.

Keywords: Photoacoustic Imaging, Medical Robotics, Medical Imaging, Surgical Guidance,

Description: Photoacoustic (PA) imaging is an emerging biomedical imaging modality based on light-generated ultrasound with unique advantages in micro-vascular structure visualization and functional imaging. Many minimal invasive surgeries currently have limited imaging guidance that potentially compromises surgical performance. With PA laparoscopic device serving as an extra real-time imaging modality providing cross-validation, the safety and efficiency of the procedure could improve significantly.

179. Nathaniel Goldfarb

Control and simulation of a lower limb exoskeleton

Department: Robotics Engineering

Advisor: Gregory Fischer

Degree Level: Ph.D.

Keywords: control, exoskeleton, learning from demostration

Description: Simulation of a lower limb exoskeleton is important to test controllers. Learning from denistration provides a power tool to teach and embed trajectories.

180. Jakub Tomasz Kaminski

The UltrasoundRobot: a portable robotic arm for a safe COVID-19 lung ultrasound screening

Department: Robotics Engineering

Advisor: Haichong Zhang

Degree Level: Master's

Keywords: COVID-19, Medical Robotics, Autonomous Systems, Ultrasonography, Medical Imaging

Description: The diagnostic lung ultrasound makes a COVID-19 patient treatment planning more effective, but is rarely done due to a high infection risk in a prolonged, direct patient-sonographer contact. We propose the UltrasoundRobot.com project, a novel robot arm which allows for a teleoperated lung ultrasound. The device improves the front-line workers safety and gives the clinical insights on the patient status, being at the same time intrinsically-safe, versatile and easily adaptable in the clinical workflow. With versatility and cost-effectiveness in mind, the robot could also serve patients in the remote and resource-limited locations.

181. Pichayut Liamthong

Text Representations of Math Tutorial Videos for Clustering, Retrieval, and Learning Gain Prediction

Department: Computer Science

Advisor: Jacob Whitehill

Degree Level: Ph.D.

Keywords: optimize learning, open educational resources, information retrieval

Description: We explored how automatically extractable text representations of math tutorial videos can help to categorize the videos, search through them for specific content, and predict the individual learning gains of students who watch them.

182. Tsung-Chi Lin

How People Use Active Telepresence Cameras in Tele-manipulation

Department: Robotics Engineering

Advisor: Zhi Li

Degree Level: Ph.D.

Keywords: Human Factors, Telerobotics, Design and Human-in-the-Loop

Description: Robot teleoperation is a reliable way to perform a variety of tasks with complex robotic systems. However, the remote control of active telepresence cameras on the robot for improved telepresence adds an additional degree of complexity while teleoperating and can thus affect the operatorâ€™s performance during tele-manipulation.

183. Fanxing Meng

Low-Cost Anthropomorphic Arm

Department: Robotics Engineering

Advisor: Michael Gennert

Degree Level: Ph.D.

Keywords: Robotic arm, Anthropomorphic arm, Low-cost, Hydro Muscle, Stepper Motor

Description: This work demonstrates that a strong and flexible anthropomorphic robotic arm can be built in under $1,000 using mostly off-the-shelf components. This brings hope to building a humanoid robot that is capable of doing most housework within $10,000 budget.

184. Nicholas Pacheco

A Kineto-Static Model for Notched-Tube Continuum Joints

Department: Robotics Engineering

Advisor: Loris Fichera

Degree Level: Master's

Keywords: Surgical Robotics, Steerable Needles, Notched-tube joints, Continuum Robotics, Kinematics

Description: This project presents a novel method for modeling the kinematics of notched-tube joints. The work displayed contributes to the understanding of how notched-tube joints move in order to improve the creation and control of miniaturized surgical instruments.

185. Fnu Raghav

Automatic Rectification of Perspective and ScaleDistortion from a Wound Image using Deep SpatialTransformation Network

Department: Robotics Engineering

Advisor: Emmanuel Agu

Degree Level: Master's

Keywords: Distortion Removal, Image Perspective, Deep Learning, Spatial Transformation Network, Computer Vision

Description: The image captured using a digital camera is utilizes perspective projection in which parallel lines converge to a vanishing point, which suffers from geometric and scale distortion due to non-standard camera angles and orientations. The proposed method automatically remove perspective and scale distortion to produce an orthogonal image. The orthogonal image is free from perspective and scale distortions and facilitates more accurate feature extraction for medical images.

186. Brianna Raphino

Intuitive Probe Motion Guidance for Teleultrasound

Department: Mechanical Engineering

Advisor: Yihao Zheng

Degree Level: Ph.D.

Keywords: Teleultrasound, Intuitive Guidance, Motion Guidance

Description: The objective is to create an intuitive guidance method that accurately guides inexperienced individuals to position and manipulate a probe in order to produce a successful ultrasound scan. The scans would be monitored in real-time by a trained healthcare professional at a remote location.

187. Alp Sahin

Planning for Within-Hand Manipulation using a Robotic Gripper

Department: Robotics Engineering

Advisor: Berk Calli

Degree Level: Master's

Keywords: robotics, gripper, manipulation, motion planning, optimization

Description: To begin writing, humans usually pick up a pen and then reposition it within their hands. Similarly, robots need to reposition tools within grasp prior to a robotic task. In this work, we break down the repositioning process into simple actions and present a method that plans for a sequence of actions to reach desired grasps on different types of objects.

188. Yinan Sun

Salamanderbot: A Flexible Continuum Mobile Robot

Department: Robotics Engineering

Advisor: Cagdas Onal

Degree Level: Ph.D.

Keywords: Soft Robotics, Mobile Robot, Motion Control, Motion Planning

Description: In this work, we introduce a new mobile robot with a continuously deformable slender body structure, the SalamanderBot, which combines the flexibility and maneuverability of soft robots, with the speed and power of traditional mobile

189. Alex Tacescu

Development of a Customizable Bio-Mechanical Actuated Knee Joint for Exoskeleton

Department: Robotics Engineering

Advisor: Gregory Fischer

Degree Level: Masters

Keywords: Exoskeleton, Bio-Mechanical Adaptive Knee, MRI Processing,

190. Yichuan Tang

Feasibility of transcranial functional ultrasound imaging of rat brain

Department: Robotics Engineering

Advisor: Haichong Zhang

Degree Level: Ph.D.

Keywords: Transcranial ultrasound Imaging, Functional brain imaging, In-vivo imaging

Description: The ultimate goal of the project is to develop an imaging modality based on ultrasound which provides functional information of brain activity. Ultrasound offers a low-cost, portable alternative compared to traditional functional imaging modalities like functional MRI. The objective of the study is to build an imaging system and phantom imaging experiments to validate its feasibility of transcranial rat brain imaging for neuroscience research.

191. Tuna Tufan

A Wearable Transcutaneous Carbon Dioxide Sensor

Department: Electrical & Computer Engineering

Advisor: Ulkuhan Guler

Degree Level: Ph.D.

Keywords: Transcutaneous CO2, Smart and connected health, Wearable, IR absorption, Thermopile sensor

Description: The partial pressure of arterial carbon dioxide (PaCO2) is an important arterial blood gas that provides significant clinical information about the respiratory and metabolic condition of a patient (such as arterial oxygenation, ventilation, and acid-base status). PaCO2 can be extracted from the partial pressure of carbon dioxide (PtcCO2), which is the measurement of CO2 molecules diffusing from the skin. This project aims to noninvasively monitor the PtcCO2 levels with a wearable sensor attached to the human body. The proposed sensor relies on the principle of CO2 absorption of infrared(IR) light at a specific wavelength.

192. Achyuthan Unni Krishnan

Nursing Robot Teleoperation via a Motion Mapping Interface

Department: Robotics Engineering

Advisor: Zhi Li

Degree Level: Ph.D.

Keywords: Robot Teleoperation, Nursing Robots, Human-Robot Interaction

Description: Tele-nursing robots have great potential to support remote healthcare in contagious disease treatment, infection control and to provide in-home assistance to the elderly and disabled. The interfaces to control these robots must be intuitive and easy to use while being ergonomic with low physical and cognitive workload. In this project such an interface developed using the motion tracking capabilities of the hand held controllers of a Virtual Reality system is presented.

193. He Wang

Design of Universal IIR Whitening Filter using Differential Evolution Algorithm

Department: Electrical & Computer Engineering

Advisor: Edward Clancy

Degree Level: Ph.D.

Keywords: Filter design, EMG, Differential evolution algorithm, Genetic algorithm

Description: Previous work has shown applying whitening filter is essential for EMG processing to remove the correlation. Universal FIR whitening filter can simplfy the process of calibrating whitening filter for each subject but it is still too complex. Base on differential evolution algorithm, a low order universal IIR whitennig filter can be designed by using the magnitude response of FIR whitening filter.

194. Haopeng Wang

Optimal Estimation of EMG Standard Deviation (EMGÏf) in Additive Measurement Noise: Model Based Derivations and their Implications

Department: Electrical & Computer Engineering

Advisor: Edward Clancy

Degree Level: Ph.D.

Keywords: Surface EMG, root mean square, additive noise

Description: Derived root difference square processing represents the maximum likelihood estimate of EMGÏf subtract the noise variance from the square of EMG RMS (or MAV), all followed by taking the square root