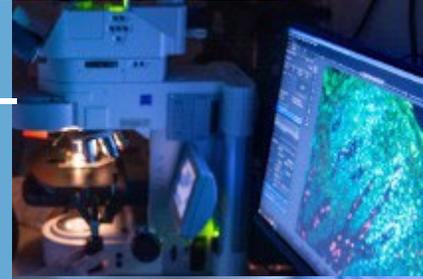# WPI

3MT
THREE MINUTE THESIS
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Graduate Research Innovation Exchange

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Three Minute Thesis

Alexandra Harrison, Chemical Engineering
Everyone's first roommate: placental models for healthier pregnancies

Oleksii Padun, Aerospace Engineering
Next-generation Mars landing vehicles: adaptive estimation for generalized autonomous atmospheric entry

Nina Klimenkova, Data Science Program
Autopilot Needs a Pilot: Let's Keep Humans in The Data Preparation Loop

Arya Eyyappally Retheeshan, Physics
Building Quantum Dots Virtually: Predicting the Future of Computing Before It's Built

Prakash Poudel, Aerospace Engineering
Coupled Sensor Configuration and Path-Planning in Disaster Response Scenarios

Rachel Hurley, Civil, Environmental and Architectural Engineering
Fighting Fire With Biology, A Cleaner Way to Remediate Smoke Damaged Materials with Enzymes

Sucheta Tamragouri, Biomedical Engineering
Growth Adaption: The Solution to Heart Valves that Don't Grow in Hearts That Do

Enis Agyeman Boateng, Social Science and Policy Studies
Bricolage: Connecting Seven Thousand Five Hundred Bottles

Hanshen Yu, Mechanical and Materials Engineering
Integrated Optimization of Drying Sequences and Process Parameters in Multi-Technology Smart Dryers

Ryo Murakami, Robotics Engineering
Sound, Light, Magnetism, and Robotics: The Quartet Against Tumors

Wafaa Almuhammadi, Computer Science
AI-Based Passive Assessment of Knee Osteoarthritis Pain

Joshua Dickie, Physics
Directing the Active River

Andrew Adiletta, Electrical and Computer Engineering
Super Suffixes: Bypassing Text Generation Alignment and Guard Models Simultaneously

Jeffrey DesRoches, Aerospace Engineering
Unfair Winds: Finding the Fastest Path Through Urban Canyons

Fatemeh Dana, Electrical and Computer Engineering
Keeping space hardware safe and reliable

Lydia Ellen Tonani-Penha, Department of Mechanical and Materials Engineering
Project Tethys: Purifying Water on Mars

Prajwal Bharadwaj, Aerospace Engineering
Designer Sand: Engineering Next-Generation Lightweight Energy Absorbers

Hanson Lee, Biomedical Engineering
Maximizing Skeletal Muscle Regeneration with Neuromuscular Derived Exosomes (NeuMusclEs)

Yunhao Zhang, Department of Mechanical & Materials Engineering
AI-Assisted Workflow for Scaling up Spray Dryer Simulations to Industrial Scale Dryers

Abeer Asif, Biology and Biotechnology
Cancer cells dodging therapy: I think not!

Nachiket Bapat, Aerospace Engineering Department
Representation Learning for Control Systems Using Deep Generative Models

Project Posters

Biomedical and Chemical Engineering Department

1. Sucheta Tamragouri

Novel Quantitative Assessment of Pediatric Growth-Adaptive Heart Valve Performance

> Department: Biomedical Engineering
>
> Advisor: Zhenglun Alan Wei
>
> Degree Level: Doctorate
>
> Description: Current prosthetic heart valves (HVs) operate at fixed sizes, forcing pediatric patients to undergo multiple surgeries due to somatic growth. Growth-adaptive pediatric HVs (GAP-HVs) offer a solution; however robust in-vitro platforms to quantify pediatric HV performance are lacking. Our objective was to develop a novel in vitro workflow for assessing the hydrodynamics and fluid mechanics of pediatric-scale heart valves using high-resolution experimental methods to capture detailed flow features relevant to valve performance.

2. Hanson Lee

Neuromuscular Derived Exosomes (NeuMusclEs) Enhance Skeletal Muscle Regeneration

> Department: Biomedical Engineering
>
> Advisor: George Pins
>
> Degree Level: Doctorate
>
> Description: Every year, approximately 5 million people require reconstructive surgeries for traumatic skeletal muscle injuries that cost approximately 800 billion dollars and causes physical disabilities. Here, we present extracellular vesicles called exosomes to enhance skeletal muscle regeneration in a 3D tissue model.

3. Fatemeh Salargarna

Predicting Patient-Specific Exercise Capacity Using MRI-Based Simulations: Application to Single-Ventricle Patients

Department: Biomedical Engineering

Advisor: Zhenglun "Alan" Wei

Degree Level: Doctorate

Description: Patients born with single-ventricle heart disease often undergo the Fontan procedure, which creates a unique circulation that can limit their ability to exercise later in life. However, it is still unclear why some patients experience more severe exercise limitations than others. In this study, we combine routine cardiac MRI with computer simulations of blood flow to better understand how energy losses in the Fontan pathway relate to exercise performance. Our findings suggest that blood flow efficiency provides additional insight beyond standard clinical measurements and may help improve how exercise capacity is evaluated in these patients.

4. Emma Slavin

A Step Beyond "One-Force-Fits-All" Foot Biomechanics: Ground Reaction Force Apportionment in a Multi-Segment Foot Model

Department: Biomedical Engineering

Degree Level: Doctorate

Description: We've developed a novel approach to estimate how ground reaction forces are distributed across four different segments of the foot during gait. This helps us understand how footwear influences foot biomechanics and loading. Applications of this work include musculoskeletal injury, adaptation, and performance.

5. Kristina MacLeod

Improving Bone Adaptation Insights Through Regional 3D Image Analysis

Department: Biomedical Engineering

Advisor: Karen Troy

Degree Level: Master's

Description: This project aims to create a new and improved way to study bone structure in specific regions using high-detail CT scans. By examining how bones respond and adapt to different physical activities and loading patterns, this work will improve our understanding of bone strength and health. The results may help identify individuals at higher risk of bone fractures, including athletes and people with low bone strength, and support the development of better prevention and treatment strategies.

6. Alireza Nikbakht

Screening and Molecular Dynamics Simulation of Antimicrobial Peptides for Bacterial Cellulose Functionalization in Chronic Wound Applications

Department: Biomedical Engineering

Advisor: Jeannine Coburn

Degree Level: Doctorate

Description: This project uses computer based tools to identify antimicrobial peptides (small proteins) that can help prevent bacterial infections in wounds. These peptides are studied with bacterial cellulose, a natural and biocompatible material commonly used in wound dressings. By simulating their interactions, we aim to select the most effective candidates for improving wound healing materials.

7. Daniel Alvarenga

Biomechanical and device parameter optimization for sonomyography-based hand gesture recognition

Department: Biomedical Engineering

Advisor: Haichong Zhang

Degree Level: Doctorate

Description: Hand gesture recognition is important for rehabilitation, enabling more accurate diagnosis, as well as allowing better human-robot interaction and assistive devices control. This project aimed to study the feasibility of reaching the optimized ultrasound configuration parameters for sonomyography-based hand gesture recognition by testing combinations of probe positions, frequency and coupling conditions. A total of 40 different configurations were tested for 16 different hand gestures which gave the results that probe position is the most significant impact on accuracy, while frequency of 1 MHz and the use of any coupling media improve performance accuracy.

8. Nina Hernandez

High-throughput evaluation of non-living and living hydrogel mechanics using a centrifugation-based approach

Department: Chemical Engineering

Advisor: Elizabeth Stewart

Degree Level: Doctorate

Description: High-throughput mechanical testing of biomaterials can accelerate their development by allowing for efficient evaluation of many material designs. My research applies a centrifugation-based approach that uses common laboratory equipment to determine when non-living and living hydrogels fail under mechanical stress. By enabling fast evaluation of hydrogel mechanics, we can use this method to inform the design of biomaterials for biomedical and manufacturing applications where understanding mechanical reliability is important.

9. Scarlett Xu

Engineering A Patient-Derived 3D Placental Model to Quantify the Effects of Oxygen Tension on Trophoblast Behavior

Department: Chemical Engineering

Advisor: Christina Bailey-Hytholt

Degree Level: Doctorate

Description: Trophoblast cells are crucial for placentation, nutrient transfer, and fetal development. Bailey-Hytholt lab is using primary trophoblast cells to develop a 3D cell model to investigate cell invasion and better understand the pregnancy related complication, such as preeclampsia.

10. Andrew Charlebois

The Role of Temperature Profiles, Phase Heating, and Slurry Velocity in Biocrude and Char Formation

Department: Chemical Engineering

Advisors: Andrew Teixeira, Michael Timko

Degree Level: Doctorate

Description: HTL, hydrothermal liquefaction, is an exciting technology for converting waste streams into a renewable source of fuel. This process has been well studied at the batch scale however converting this to a continuous process is less well understood. To better understand this, several batch and continuous HTL experiments were run to determine the heuristics that matter for hydrothermal process scale up.

11. Archer Moore

Cold Sintering of Wollastonite-Derived Calcite and Silica

Department: Chemical Engineering

Advisors: Andrew Teixeira, Michael Timko, Mingjiang Tao

Degree Level: Doctorate

Description: Cold sintering is a technique to produce ceramic materials using lower temperatures and higher pressure than conventional sintering, while obtaining similar densification, with lower overall energy use. Wollastonite, a common mining waste, can be used as a source for silica (silicon dioxide) and calcite (calcium carbonate). When these compounds are combined in the same ratio that they are produced from wollastonite, and cold sintered together, the resulting material has greater compressive strength than would be obtained from wollastonite alone.

12. Belle Sethachutkul

Rethinking Natural Gas: Oxidative Regeneration Enables Methane into Carbon Nanotubes and Hydrogen

Department: Chemical Engineering

Advisor: Andrew Teixeira

Degree Level: Doctorate

Description: Producing hydrogen with methods that either limit or avoid greenhouse gas emissions is an important challenge. In this work, we rethink the chemistry on a molecular level and focus on the possibility of pulling hydrogen off methane and leaving behind carbon as a valuable material like carbon nanotubes instead of carbon dioxide. By using oxygen to periodically clean the system during operation, we are able to keep hydrogen production and carbon nanotube growth more sustained.

13. Aubrey Graham

The role of polyelectrolytes in increasing xylose yields from the hydrolysis of bamboo using a solid acid catalyst

Department: Chemical Engineering

Advisor: Michael Timko

Degree Level: Doctorate

Description: The research focuses on understanding the role of the polyelectrolyte PDADMAC in converting polysaccharides in bamboo into simple sugars using ferrierite, a solid acid catalyst. Solid acid catalysts are preferable to traditional acids to decrease downstream production costs, but the similar surface charges on bamboo and ferrierite particles limit the reaction. PDADMAC plays an important role in moderating the interaction of particles in the reaction to increase the yield of key bamboo hydrolysis products, such as the sugar xylose.

Business, Social, and Learning Sciences

14. Allen Guiterrez

Prompting Innovation from Scarcity: How Custom GenAI Augment Entrepreneurial Creativity in Resource-Constraint Ecosystems

Department: Business - Entrepreneurship

Advisor: Rosanna Garcia

Degree Level: Doctorate

Description: This poster examines how GenAI tools may support early stage entrepreneurs in resource constrained ecosystems to develop novel and commercially viable business ideas. Using a survey study and an experimental study, the research explores how entrepreneurs interact with GenAI through their prompts and how different types of GenAI support shape idea development. The study also examines the use of large language models as judges to evaluate ideas when access to expert mentors and domain specific market knowledge is limited, focusing on entrepreneurs in Panama and the United States.

16. Eliot Szary

Using Plot Structures To Write Visual Novels

Department: IMGD

Degree Level: Master's

17. Christian Rua

Examining In-Practice Usage of Digital Teacher Dashboards for Identifying Student Strategic Thinking in Mathematics

Department: Learning Sciences

Advisor: Erin Ottmar

Degree Level: Master's

Description: We have been developing a prototype dashboard that helps middle school algebra teachers identify the strategies that their students use to solve math problems. The dashboard has been co-designed alongside teachers every step of the way in order to meet the needs that we have identified based on their comments and feedback. Our current study involves examining how in-service teachers actually make use of the tools in the classroom and how the data visualization(s) help inform their teaching.

18. Zelda Ferris

Perceptual Features of Arithmetic Expressions Bias Visual Attention

Department: Learning Sciences

Advisor: Erin Ottmar

Degree Level: Master's

Description: We investigated how differences in cognitive ability and the presentation of mathematical terms affect where people look during the solving of order of operations problems. Gaze measures are an indicator of attention when solving math. We found that changing the color of math problems shifts the timing of attentional allocation. This finding indicates that color is a powerful tool to influence problem solving strategy.

19. Wilson Gramer

Type Circuits: A Visual Computer Science Activity for Connection-Making and Confidence

Department: Learning Sciences

Advisor: Stacy Shaw

Degree Level: Master's

Description: Computer science novices often receive difficult-to-understand error messages that can hurt confidence. To help students build confidence, I will introduce Type Circuits, a visualization tool and hands-on paper modeling activity that aims to demystify how computers produce semantic errors. Type Circuits supports multiple programming languages and can automatically generate activities for CS teachers to use in the classroom.

20. Varun Bhat

GJMate - A digital platform for local green job uptake

Department: Community Climate Adaptation

Advisor: Sarah Strauss

Degree Level: Doctorate

Description: GJMate is a gamified, contextual web platform that helps job seekers connect to local jobs, training resources, knowledge about green industries, employers, and other opportunities in the region. The goal of the platform is to support cities in Massachusetts and the United States in their challenge to develop a robust and local green workforce. It creates a gamified environment that provides a starting point for new graduates and transitioning workers to dip their toes into the local green job scene. The platform can also help policymakers and researchers get better information about what motivates the green workforce to participate in the green labor market.

Computational, Data, and Mathematical Sciences

21. Wafaa Almuhammadi

AI-based Passive Assessment of Osteoarthritis Pain

>Department: Computer Science
>
>Advisor: Emmanuel Agu
>
>Degree Level: Doctorate
>
>Description: To address the inaccuracies inherent in self-reports, this research project explores using Artificial Intelligence (AI) to analyze body-worn sensor data for passive assessment of the pain felt by patients with osteoarthritis. Our objective approach enables personalized, real-time pain monitoring that dynamically adapts to patients changing conditions.

23. Tasnova Tabassum

Fuzzy ARTMAP Neural Network for Explainable AI

>Department: Computer Science
>
>Advisor: Walter Gerych
>
>Degree Level: Doctorate

24. Samuel Uche

AI-Powered Detection of Alcohol Intoxication Using Smartphone Gait Data

>Department: Computer Science
>
>Advisor: Emmanuel Agu
>
>Degree Level: Doctorate
>
>Description: This research develops artificial intelligence models that can detect alcohol intoxication by analyzing how people walk using smartphone sensors. By examining gait patterns captured through accelerometer and gyroscope data, our deep learning system can accurately identify impaired walking and assess levels of intoxication. This technology has the potential to enhance public safety by providing real-time impairment detection through devices people already carry, and our collaborative work has also extended these methods to marijuana detection.

25. Jessica Elmhurst

Automated Scan-Viability Mapping Using Image Segmentation for Optical Coherence Tomography on Donor Kidneys

Department: Computer Science

Advisor: Haichong Zhang

Degree Level: Master's

Description: Optical Coherence Tomography (OCT) provides high-resolution imaging of tissue microstructures, which is particularly useful for evaluating transplant kidneys. However, kidney imaging is challenged by the need for precise targeting and by the presence of surrounding fat, which can obscure the organ surface. This project applies a deep learning image segmentation approach to distinguish kidney tissue from fat, generating a viability map to guide probe movement and optimize scan acquisition.

26. Nina Kilmenkva

Table Unionability Is Uncertain and That's Why Humans and AI Need Each Other

Department: Data Science

Advisor: Roee Shraga

Degree Level: Doctorate

Description: Many real-world analyses require combining information from different datasets, but deciding whether two datasets actually belong together is often confusing and inconsistent. This poster presents a benchmark and user study that capture how people decide whether two data tables should be unioned, including their confidence and reasoning under uncertainty. Using these human signals, we examine how decision quality can be improved with machine learning and how large language models behave when provided with varying levels of human context. The results provide insight into the strengths and limitations of human, ML, and LLM-based judgments in data discovery.

27. Karen Bonilla

Adding Context to Data Visualization Tasks by Characterizing Expert Strategies

Department: Data Science

Advisor: Lane Harrison

Degree Level: Doctorate

Description: While visualizations (i.e. charts) are most useful when it comes to navigating daily tasks such as personal finances management and work-related visualization use, many of the studies in the area rely on abstracted tasks (i.e. that do not reflect how they are used in context) for measuring visualization literacy. As a result, they also influence the approaches used to teach those not familiar with a chart how to interpret it. The research presented aims to instead focus on context or domain-specific data visualization use by experts as a first step towards creating approaches to teaching these visualizations to non-experts.

28. Hammed Olayinka

Bayesian Predictive Inference for Multiple Series with Correlated Spatial Priors on Autoregressive Parameters

Department: Mathematical Sciences

Advisor: Balgobin Nandram

Degree Level: Doctorate

Description: My poster presents a new way to forecast many related time series by letting nearby areas share information. This neighborhood pooling improves accuracy and gives clearer uncertainty ranges when each area has only a little data. The approach is simple to use and can help with regional planning and other real-world decisions.

29. Taorui Wang

Dealing with non-convex optimization with physics informed temperature

Department: Mathematical Sciences

Advisor: Zhongqiang Zhang

Degree Level: Doctorate

Description: I address non-convex optimization problems in high dimension through Hamilton-Jacobi-Bellman (HJB) equation where a temperature- parameter controls the exploration vs exploitation balance in non-convex optimization. Through Physics Informed Neural Networks (PINNs), we design an adaptive, state-dependent temperature control to solve optimization problems with stable and scalable Langevin Dynamics. This is relevant across domains that use stochastic optimization and decision-making e.g., robotics, reinforcement learning, finance.

30. Prakash Poudel

Application of Coupled Sensor Placement and Path-Planning in a Disaster Management Scenario

Department: Aerospace Engineering

Advisor: Raghvendra Cowlagi

Degree Level: Doctorate

Description: In this poster, we present the application of the coupled sensing and path planning (CSCP) method to a real flood environment using a data driven threat model. In this CSCP framework, sensors are strategically placed to reduce uncertainty in the path rather than the environment. Overall, we propose a framework that provides an optimal path for an actor to navigate the flooded environment with minimal exposure, utilizing a few but high quality sensor measurements.

32. Oleksii Padun

Next-generation Mars entry vehicles: adaptive estimation for generalized atmospheric entry

Department: Aerospace Engineering

Advisor: Ye Lu

Degree Level: Doctorate

Description: This research introduces a navigation framework designed to help spacecraft land more accurately and safely on Mars. By processing data from on-board sensors, the system can distinguish between environmental disturbances and the vehicle's own aerodynamic uncertainty in real time, allowing for autonomous adaptation. This framework addresses the challenges of the high-variance Martian atmosphere and complex hypersonic effects, providing a robust solution for next-generation mission designs.

33. Alexandra Ballentine

Physics-Informed Neural Networks for Optimal Control

Department: Aerospace Engineering

Advisor: Raghvendra Cowlagi

Degree Level: Doctorate

Description: Solutions to optimization problems in optimal control often require the solution of complex, nonlinear differential equations. While these problems are difficult to solve using traditional solvers, physics-informed neural networks (PINNs) are able to provide feasible solutions with low numeric error.

34. Maria Wojciechowski

Trajectory Optimization for Cooperative Navigation by solving the HJB Equation using PINNs

Department: Aerospace Engineering

Advisors: Raghvendra Cowlagi, Michael Steffens

Degree Level: Doctorate

Description: Cooperative navigation is a methodology where multiple mobile vehicles share navigational aiding information with the aim of improving the precision and accuracy of localization. One approach is to assign the role of aid vehicle to one vehicle, and to then optimize the trajectory of the remaining vehicle to achieve sufficient proximity to the aid vehicle while conducting its tasks. We formulate this problem as an optimal control problem and develop a Physics-Informed Neural Network (PINN) to solve the Hamilton-Jacobi-Bellman equation for the cooperative navigation problem of maximizing the aid received from an aid vehicle while also minimizing the time of travel.

35. Terrence McFarland

Identification and quantification of extractable compounds from tire rubber: Representative chemical profiles as a basis for environmental risk assessment of tire-derived contaminants

> Department: Civil and Environmental Engineering

> Advisors: John Bergandahl, Stephen Kmiotek

> Degree Level: Doctorate

> Description: An underrecognized type of microplastic, tire wear particles represent a distinct pollutant whose effects extend beyond their particulate form. Tire tread consists of a vast consortium of leachable additives that have been detected in stormwater runoff, surface waters, roadside soils, and the atmosphere. Furthermore, acute toxic effects of tire-derived chemicals to aquatic life have been observed in laboratory and environmental settings. As tire-derived chemicals originate from a complex and variable source material, environmental risk assessment is hindered without efforts toward systematic characterization and prioritization of the chemical space associated with tire wear emissions. This work served to develop a representative chemical profile of tire-derived contaminants by integrating occurrence, mass loading, and screening-level fate considerations, providing a foundation for improved environmental monitoring and risk assessment.

36. Rachel Hurley

Indoor Material Properties Drive Prolonged Wildfire Sourced VOC Re-emission

> Department: Civil and Environmental Engineering

> Advisor: Shichao Liu

> Degree Level: Doctorate

> Description: In this work, we investigate the behaviors of how wildfire smoke contaminated materials emit smoke gaseous pollutants (known as volatile organic compounds) over time. Wildfire smoke contaminated materials can become sources of indoor smoke exposure as they re-emit these pollutants, endangering human health long after a wildfire event has passed. By understanding how to properties of different indoor materials and compounds influence the timescale of VOC re-emission, we can better understand how people are exposed to these compounds long after a wildfire event and determine best smoke remediation strategies.

37. Atharva Pandhare

Low-Temperature Electrochemical Reduction of Iron Oxide for Sustainable Iron production

> Department: Materials Science and Engineering

> Advisor: Yan Wang

> Degree Level: Doctorate

> Description: Low temperature electrochemical processing is a new and environmentally friendly way to produce iron and other metals without generating carbon dioxide. By using electricity instead of carbon based methods, iron oxide is directly converted into high purity iron while releasing only oxygen. This approach can significantly reduce pollution from metal production and support cleaner manufacturing in the future.

38. Jize Zhang

Integrated High-Throughput Computational Design of High-Entropy Alloys

> Department: Materials Science and Engineering

> Advisor: Yu Zhong

> Degree Level: Doctorate

> Description: The design of alloys containing more than five elements is challenging. This project aims to use an advanced computational method to improve the properties of multi-element alloys.

39. Adam Shenk

Breaking the Charge Neutrality Boundary in Perovskite Using the PyCALPHAD Approach

> Department: Materials Science and Engineering

> Advisor: Yu Zhong

> Degree Level: Doctorate

> Description: Perovskites are ceramic oxide materials commonly used as cathodes in hydrogen fuel cells. During operation, a difference of charge occurs between the surface and bulk of each perovskite crystal. This study applies computational thermodynamics to enforce a charge balance, allowing for a deeper understanding of defect chemistry and conductivity of these fuel cell components.

40. Jaemin Kim

Na-deficient P2 Cathode with High-entropy Bulk Doping Strategy

Department: Materials Science and Engineering

Advisor: Yan Wang

Degree Level: Doctorate

Description: This poster presents a new sodium ion battery cathode design that uses a high entropy bulk doping strategy to improve performance and stability. By combining a sodium deficient P2 structure with multiple stabilizing elements, the material enables faster sodium ion movement and longer cycle life. This work highlights a promising pathway for low cost and sustainable energy storage applications.

41. Pardis Pourhaji

Durability of Enzymatic Self-Healing Concrete

Department: Civil, Environmental and Architectural Engineering

Advisor: Nima Rahbar

Degree Level: Doctorate

Description: Concrete structures often deteriorate prematurely due to steel corrosion, leading to high maintenance costs and increased environmental impact. This study investigates the use of carbonic anhydrase to promote self-healing in concrete by accelerating the reaction between available calcium in the cement matrix and atmospheric CO_2 to precipitate calcium carbonate, which refines pore structure and slows the ingress of aggressive agents. The results demonstrate improved durability, delayed corrosion initiation, reduced corrosion severity during service, and a significant extension of concrete service life. Overall, enzymatic self-healing concrete has strong potential to enhance infrastructure sustainability and contribute to reducing CO_2 emissions associated with cement-based materials.

42. Jorge Valdivia

Ignition of wood by convection and radiation heating

> Department: Fire Protection Engineering
>
> Advisors: James Urban, Albert Simeoni
>
> Degree Level: Doctorate
>
> Description: Woody fuels in fires are often exposed to both radiative heating and hot gas convection, yet how these combined heating modes control ignition is not well understood. This work couples controlled laboratory experiments with a physics-based model of internal thermal degradation to examine how non-uniform radiative and convective heating drives the transition from virgin wood to char and ultimately ignition. The results reveal how external heating patterns and internal material behavior together govern ignition thresholds in small woody fuels.

Life and Physical Sciences Department

43. Domonic Radcliffe-Hines

Cofilin controls the sorting of tropomyosin to distinct actin networks

> Department: Bioinformatics
>
> Advisor: Shane McInally
>
> Degree Level: Doctorate
>
> Description: Cellular function necessitates the simultaneous assembly of multiple support and mobility structures, including multiple actin structures. If these structures are all made of the same building blocks, how does the cell build networks with distinct functions? We use yeast as a model to answer this question using a combination of live-cell microscopy and CRISPR gene manipulation.

44. Abeer Asif

Dynamic regulation of Suv420H2 at mitotic centromeres is phosphorylation dependent

Department: Biology and Biotechnology

Advisor: Amity Manning

Degree Level: Doctorate

Description: Centromere transcription during mitosis is critical for the recruitment of key kinetochore proteins and is limited, in part, through the establishment of the repressive, heterochromatin-promoting trimethylation of Lysine 20 on Histone H4 at the pericentromere. However, the mechanism by which high H4K20me3 is maintained at the pericentromere, yet precluded from the adjacent centromere, remain unclear. Here we show that chromatin binding of Suv420H2, the enzyme responsible for trimethylation of H4K20, is regulated during mitosis by dynamic phosphorylation.

45. Alexander Freeman

Investigation of Centromere damage-induced mitotic errors

Department: Biology and Biotechnology

Advisor: Amity Manning

Degree Level: Doctorate

Description: During cell division DNA is compacted into structures called chromosomes, and spindle microtubules attach to the center of the chromosomes. The chromosomes are then pulled to segregate them equally into the 2 resulting daughter cells. Disruption of this process can lead to errors in chromosome segregation. Ongoing work seeks to investigate how DNA damage at the centromere impacts this segregation process.

47. Shruti Shastry

You Are What You Eat: Peptide Rescue in C. elegans

Department: Biology and Biotechnology

Advisor: Jagan Srinivasan

Degree Level: Doctorate

Description: The study of peptides, especially neuropeptides in C. elegans requires a resolution that is currently not achievable by current technologies. Using the novel approach of rescue-by-feeding, mutant C. elegans can regain function of lost peptides, enabling the study of the peptide and it's behavioral phenotype.

48. Racheal Asaolu

The Real Drama Queens: How C. elegans Handles Particulate Matter (PM2.5)

Department: Biology and Biotechnology

Advisor: Jagan Srinivasan

Degree Level: Doctorate

Description: Air pollution is a complex mixture that impacts both climate and human health. Prolonged exposure to fine particulate matter (PM2.5), a major component of air pollution, has been linked to increased risk of neurodegenerative diseases such as Parkinson and Alzheimer. Because PM2.5 particles are extremely small, they can enter the bloodstream and may cross the blood-brain barrier, reaching brain tissue. Over time, repeated exposure may trigger inflammation and cellular stress that contribute to neurodegeneration. Air pollution is a complex mixture that impacts both climate and human health. Prolonged exposure to fine particulate matter (PM2.5), a major component of air pollution, has been linked to increased risk of neurodegenerative diseases such as Parkinson disease and Alzheimer disease. Because PM2.5 particles are extremely small, they can enter the bloodstream and may cross the blood-brain barrier, reaching brain tissue. Over time, repeated exposure may trigger inflammation and cellular stress that contribute to neurodegeneration.

49. Kristen Metzler

Selenium-Mediated Protection Against Lead-Induced Neurobehavioral and Reproductive Toxicity

Department: Biology and Biotechnology

Advisor: Natalie Farny

Degree Level: Doctorate

Description: This poster explores how the nutrient, selenium, can help protect living cells from the harmful effects of lead exposure. Using both a tiny model organism (C. elegans) and mammalian cells, I examine how selenium supports brain-related behaviors and reproductive health. My findings highlight how natural protective pathways may reduce damage caused by toxic metals.

50. Samuel Isife

Reducing Scarring from Fibrosis with Plant Extracts

Department: Biology and Biotechnology

Advisor: Pamela Weathers

Degree Level: Doctorate

Description: This project investigates how extracts of Artemisia medicinal plants affect human skin fibroblasts, the cells responsible for driving scar formation. The study evaluates whether plant derived treatments may offer safer and more cost-effective ways to limit processes that contribute to scar-forming fibrosis.

52. Rebecca Gilchrist

In situ Studies on the Vapor Mediated Hydrolysis of LiAlH4 Spark Interest for On-Demand Hydrogen Storage Applications

Department: Chemistry and Biochemistry

Advisors: Ronald Grimm, Andrew Texeira

Degree Level: Doctorate

Description: Transportation contributes to roughly 20% of global CO_2 emissions, so clean energy alternatives are crucial. One promising solution is using hydrogen to power select light duty vehicles such as passenger cars, SUVs, and commercial vehicles. Complex metal hydrides are ideal for on-board hydrogen storage because they are lightweight, can store large amounts of hydrogen within the material, and offer on-demand hydrogen release. We study the mechanism of the vapor mediated hydrolysis of lithium aluminum hydride (LiAlH4) to deconvolve the reaction pathway and provide insight that will help inform strategies to fine tune reactivity and optimize LiAlH4 for on demand hydrogen storage applications.

53. Arya Eyyappally Retheeshan

Multiphysics Simulation of Strain-Engineered InAs/GaAs Quantum Dots Using Hermite Finite Elements

Department: Physics

Advisor: L. Ramdas Ram-Mohan

Degree Level: Doctorate

Description: Quantum dots are nanoscale semiconductor crystals that confine electrons so tightly that quantum mechanics determines their behavior. We developed a computational framework that simulates quantum dots formed by embedding indium arsenide crystals within gallium arsenide semiconductors. Since these materials have different lattice constants, mechanical strain develops which alters electronic properties. Using advanced finite element methods with Hermite elements, we predict electron energy levels and wavefunction distributions with accuracy comparable to experimental measurements.

54. Omid Mahdavi

Modeling and simulation of a flow electrolysis cell for sustainable Iron production

Department: Mechanical Engineering

Advisor: Adam Powell

Degree Level: Doctorate

55. Jonathan Oliveira Luiz

Full-Field Evaluation of Middle Ear Nonlinearities Across Moderate and High-Intensity Sound Levels by High-Speed 3D-DIC and LDV

Department: Mechanical Engineering

Advisors: Cosme Furlong, Jeffrey Cheng, John Rosowski

Degree Level: Doctorate

Description: This poster presents advanced optical methods used to study how the middle ear responds to different sound levels, from moderate acoustic clicks to high-intensity blasts. By combining high-speed imaging with laser-based measurements, we evaluate how eardrum motion changes as sound intensity increases and identify behaviors that cannot be explained by simple linear models. These findings contribute to a better understanding of sound transmission in the ear and may help inform future research related to hearing function, injury mechanisms, and protective strategies.

54. Seyed Hamad Ghavami

In-the-field Rapid Detection of Viable Foodborne Pathogenic Bacteria by Bacteriophage-loaded Acrylic-tape Microfluidics

Department: Mechanical Engineering

Advisor: Yuxiang Liu

Degree Level: Doctorate

Description: Salmonella bacteria cause over 1.35 million infections and 420 deaths annually in the U.S., motivating the development of a portable microfluidic device for rapid detection of foodborne bacteria using bacteriophages as biospecific sensing elements. The device reduces detection time by more than an order of magnitude compared with traditional plating methods and differentiates between live and dead bacteria. A limit of detection of ~10^4 cells/mL is achieved in less than one hour, representing over a tenfold reduction in detection time relative to culture-based assays. These proof-of-concept results with Salmonella enterica demonstrate the potential for rapid, in-situ foodborne pathogen detection in civil and military applications.

57. Diego Vaca Revelo

Energy Conversion Mechanisms in Microbubble-Enhanced Focused Ultrasound Therapy for Tissue Temperature Elevation

Department: Mechanical Engineering

Advisor: Aswim Gnanaskandan

Degree Level: Doctorate

Description: High-intensity focused-ultrasound (HIFU) therapy is a medical procedure to treat subsurface prostate cancer. It uses acoustic waves to locally elevate the temperature of the biological tissue to cause ablation. The literature suggests that the presence of microbubbles modifies the ultrasound field in the focal region and significantly enhances heat deposition. This study aims to numerically elucidate the acoustic to thermal energy conversion mechanisms in microbubble-assisted high-intensity focused ultrasound therapy.

58. Yan Wu

Continuous, Real-Time Sensing for Food and Biochemical Applications Using Fiber-Optic Technologies

Department: Mechanical Engineering

Advisor: Yuxiang Liu

Degree Level: Doctorate

Description: We demonstrate how real-time in-line measurements by optical fiber sensing can improve safety and quality in different applications. One pressure sensor is used to monitor blood clot suction in medical procedures, while the other uses near-infrared spectroscopy to track attributes in cookie dough during baking. Together, these sensors highlight how engineering solutions can provide timely information for better decision making in healthcare and food production.

59. Sanaz Marefati

Bubble removal using pressure swing operation

Department: Mechanical Engineering

Advisor: Mehdi Mortazavi

Degree Level: Doctorate

Description: My research focuses on making green hydrogen production more efficient by removing gas bubbles that get trapped inside electrolyzers. I am testing a pressure swing method that uses physics to force these bubbles to detach, which reduces energy waste. This work aims to make renewable energy more affordable and effective for a cleaner future.

60. Amir Abdollahpour

Oscillation of Sessile Droplets under Confined Shear Gas Flow

> Department: Mechanical Engineering

> Advisor: Mehdi Mortazavi

> Degree Level: Doctorate

> Description: A droplet on a surface starts to oscillate and deform when air flows over it. This motion is measured and analyzed to uncover the physical rules that govern it. Understanding these behaviors can help support advances in technologies such as clean-energy fuel cells and efficient thermal management.

61. Mana Masrouri

Hybrid Heat Pump Technology for Waste Heat Recovery in Industrial Drying Processes

> Department: Mechanical Engineering

> Advisor: Jamal Yagoobi

> Degree Level: Doctorate

> Description: Drying is one of the most energy-intensive operations in manufacturing. Across industrial manufacturing processes, an estimated 20 - 50% of energy input is lost as waste heat, often via high temperature exhaust air. Recovering this waste heat is therefore essential to improve overall system efficiency. High temperature heat pumps offer a promising pathway to upgrade this waste heat to useful thermal input for drying. This work investigates a hybrid waste heat recovery system that integrates high temperature heat pumps with auxiliary heating and preheating heat exchangers.

62. Lindsey Podlaski

Impact of Dielectrophoretic Vapor Extraction Force on Electronics Performance

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Doctorate

Description: Modern electronic systems are advancing rapidly, driving devices to operate at higher power levels within increasingly compact and challenging environments. This study addresses the performance of electronic cooling with the aid of DEP mechanism and is illustrated with the use of a Raspberry Pi 5 by cooling the CPU surface in three orientations. Results show that the use of DEP for vapor extraction successfully decreases the CPU surface temperature, as well as maintains, and in some cases improves, the performance and functionality of the Raspberry Pi 5.

63. Zahra Nazariharavani

Impact of Atmospheric-Pressure Cold Plasma Pretreatment on the Drying Process of Berries

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Doctorate

Description: Hot-air drying of fruits is energy-intensive and often limited by skin/cuticle resistance, which can prolong drying time and degrade product quality. Since product-quality constraints (e.g., color and texture) limit allowable thermal loading, upstream nonthermal pretreatments that reduce mass-transfer resistance can improve drying performance without relying solely on higher temperatures. Atmospheric cold plasma can enhance drying through surface modification (e.g., creating of microholes and microchannels) that reduces skin/cuticle mass-transfer resistance, as well as through air flow creation by ionic wind that intensifies near-surface convection and increases the local heat-transfer coefficient. This work presents an experimental and numerical investigation of atmospheric cold plasma pretreatment in the drying of berries.

64. Matthew Catuccio

Dielectrophoretic-Driven Pool Boiling Experiment Aboard Blue Origin Shepard Spacecraft

Department: Mechanical Engineering

Advisor: Jamal Yagoobi

Degree Level: Doctorate

Description: The continued development of electronic systems in satellites and future space-based data centers requires novel thermal management systems to allow for the highest performance. Two-phase thermal management systems are limited by the lack of buoyancy, as bubbles do not depart from their heated surface. This work presents an investigation on Dielectrophoretic (DEP) vapor extraction aboard a Blue Origin sub-orbital flight with three minutes of microgravity.

Robotics, Electrical, and Systems Engineering

65. Andrew Adiletta and Co-Presenters - Kemal Derya and Kathryn Adiletta

Super Suffixes: Bypassing Text Generation Alignment and Guard Models Simultaneously

Department: Electrical and Computer Engineering

Advisor: Andrew Adiletta

Degree Level: Doctorate

Description: Jailbreaking techniques that break LLM alignment and force services like ChatGPT to produce undesirable text (cyber threats, biological weapons, hate speech, etc...) has necessitated the development of Guard models, which classify input prompts as malicious or benign before they are given to text generation models. This research is the first of its kind to apply novel algorithmic prompt engineering techniques to jointly fool Guard models and text generation models simultaneously. We additionally develop new techniques for detecting these attacks by analyzing how the model internals change as the LLM processes a sequence of tokens.

66. Fatemeh Khojasteh Dana

Keeping space hardware safe and reliable

Department: Electrical and Computer Engineering

Advisor: Shahin Tajik

Degree Level: Doctorate

Description: My poster explains how attackers or harsh space conditions like radiation can cause tiny errors in satellite electronics and why that can be dangerous. I show a way to quickly notice these problems and help the system recover so the space hardware stays safe and reliable.

67. Amin Hazrati Marangalou

A 6.78-MHz Active Rectifier With Digitally Controlled On-Chip Power Switch Size Calibration for Wirelessly Powered Biomedical Devices

Department: Electrical and Computer Engineering

Advisor: Ulkuhan Guler

Degree Level: Doctorate

Description: Wireless power transfer allows medical devices to receive energy without batteries or physical wires, making them smaller, safer, and more comfortable to use. This is especially important for biomedical devices worn on the body or implanted inside it, where replacing batteries can be difficult, painful, or even require surgery. By delivering power wirelessly, these devices can operate continuously and reliably while improving patient comfort and long-term health monitoring.

68. Cole Welcher

Contact-Aware Kinematics for Non-Coaxial Nested Continuum Robots with Arbitrary Play and Cross-Section

Department: Robotics Engineering

Advisors: Giovanni Pittiglio, Loris Fichera

Degree Level: Master's

Description: This poster presents research on concentric tube robots, a type of continuum robot, that is made from nested, precurved tubes. The work focuses on improving how these robots are modeled so they can better account for contact, friction, and interaction within their structure and surrounding environment. These advances will enable safer and more accurate motion in complex anatomical spaces.

69. Shambhuraj Mane

Vibration-induced Friction Modulation to Enable Controlled Sliding for In-hand Manipulation

Department: Robotics Engineering

Advisor: Berk Calli

Degree Level: Doctorate

Description: This poster shows how robots can move and adjust objects within their grasp by vibrating their fingers to control the coefficient of friction at the finger-object contact. By turning vibrations on and off, the robot can make objects stick or slide as needed, enabling controlled rolling or sliding movements, respectively, without letting go.

70. Yernar Zhetpissov

Optical Coherence Tomography Donor Kidney Imaging Using a Virtual Fixture-Equipped Robot

Department: Robotics Engineering

Advisor: Haichong Zhang

Degree Level: Doctorate

Description: This poster is about a development of a robotic imaging system that helps scan an entire kidney with optical coherence tomography (OCT) while keeping the probe safely away from the tissue. The robot uses a software safety boundaries from depth camera and shared human control so the operator can position the probe while the system prevents collisions and maintains an optimal scanning path. This approach aims to make high-resolution kidney assessment faster and safer for pre-transplant evaluation.

71. Seyedali Golestaneh

ActivePusher: Active Learning and Planning with Residual Physics for Nonprehensile Manipulation

Department: Robotics Engineering

Degree Level: Doctorate

Description: This work presents AURA, a planning method that keeps improving a robot's route while it's moving, rather than deciding everything in advance. By continuously replanning and fine-tuning the robot's actions to handle real-world unpredictability, it reaches better, more efficient paths than existing approaches in both simulations and physical tests.

72. Tae Wan Kim

Needle Tip Position Estimation Simulation through Bendable GRIN Lens

Department: Robotics Engineering

Advisors: Haichong Zhang, Nobuhiko Hata

Degree Level: Doctorate

Description: Utilizing long, bendable Graded Index (GRIN) lens endoscopy, we can estimate the position of a needle tip during medical insertion. We predict the position by calculating the field of view shift and deformation that occurs when bending the lens in simulation.

73. Xihan Ma

Towards Autonomous Kidney Ultrasound: Spatial Efficient Volumetric Imaging via Template Guided Optimal Pivoting

Department: Robotics Engineering

Advisor: Haichong Zhang

Degree Level: Doctorate

Description: A robotic system is developed for renal ultrasound examination. The system estimates the optimal ultrasound probe pose to perform a whole kidney pivoting sweep. This is done by matching partial kidney images of the patient with a generic kidney template model. An accurate 3D kidney model can be built through the sweep scan, which can be saved for more efficient subsequent intra-patient imaging.

74. Harsh Shah and Co-Presenter - Harsh Chhajed

ARBot: A High-Fidelity Robotic Manipulator Teleoperation Framework for Human-Centered Augmented Reality Evaluation

Department: Robotics Engineering

Advisor: Tian Guo

Degree Level: Master's

Description: This project presents ARBOT, a robotic platform designed to improve how we test and evaluate Augmented Reality technology. By recording natural human hand movements and replaying them precisely with a robotic arm, our system creates a consistent way to measure performance without the variability of human error. This approach helps researchers accurately distinguish between software glitches and user mistakes to build better AR experiences.

75. Krish Patel

Artificial Intelligence for Technical Debt in Systems Engineering Work Products

Department: Systems Engineering

Advisor: Shams Bhada

Degree Level: Doctorate

Description: This poster shows how artificial intelligence can help engineers review large technical documents more quickly and consistently. It demonstrates a system that reads project plans, finds unclear or missing requirements, and points engineers to relevant standards for improvement. The goal is to reduce errors early in complex projects and support better engineering decisions.