Summer Research Initiative (SURI) 2024 Projects

School of Electrical, Computer and Energy Engineering (ECEE)

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Mariana Bertoni	**ECEE**	**Characterization of Solar Energy Materials**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: This project focuses on developing novel processing techniques to achieve high dopant incorporation in CdTe solar cells. The research will involve processing of CdTe films and carrying out materials characterization to understand the obtained structure, composition, and electrical properties. **Students will:** Gain experience in thin film materials processing, materials characterization tools such as X-ray diffraction and absorption, glow discharge optical spectroscopy. The student will develop skills in data analysis and modeling. **Prerequisite skills/knowledge:** Students with previous chemistry lab experience and a background in Materials Science or Chemistry.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Vidya Chabria	**ECEE**	**Electronic design automation and digital circuit design**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: The objective of the research is to apply machine learning techniques to solve challenging problems in chip design. **Students will:** Develop algorithms and write software for traditional EDA applications for ground truth data generation then apply machine learning techniques to make the algorithm more scalable. **Prerequisite skills/knowledge:** Knowledge in Python and C++ is required. Course: Algorithms, data structures, circuit design, VLSI design.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Zhaoyang Fan	**ECEE**	**Neuromorphic devices**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: The project is to use phase change materials to create novel neuromorphic devices and circuits for non-Si based neuromorphic computation. **Students will:** The student will learn to simulate the device and circuit functions, fabricate the devices and create the circuits, and test their performance. **Prerequisite skills/knowledge:** Familiar with MATLAB/Simulink, Python, and basic knowledge of neural networks.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Zachary Holman	**ECEE**	**Solar Cell Fabrication & Characterization, Device Physics, Nanoparticle Deposition**	**ASU Research Park**	**U. S. Citizen or non-U. S. Citizen**

Project description: Perovskite/silicon tandem solar cells are an emerging solar energy technology which have surpassed the sunlight-to-electricity conversion efficiency of silicon solar cells but suffer from long-term stability issues and fabrication challenges. In this summer research internship, you will be working with researchers in the Holman group to understand and quantify performance losses in perovskite/silicon tandems made at ASU, which is one of a few institutions globally that can make these devices. This will include learning a wide range of measurement techniques to best understand these devices, working with Holman group researchers to develop various long-term stability measurements, and discussing the results of your measurements with researchers in order to help improve pilot-scale solar cell manufacturing. **Students will:** Spend at least 60% of their time in the lab performing research. Part of this research is on measuring solar cells. This will include hands-on use of electrical equipment, imaging techniques (cameras, microscopes, advanced metrology), and other light-based imaging techniques. Some programming knowledge will be helpful for compiling this data. Other research will include developing long-term stability tests, which will require the use of different test chambers. The rest of the time will be spent gathering the results of the tests and communicating them to the Holman research group using software like JMP and Origin. **Prerequisite skills/knowledge:** Knowledge of basic circuits and any programming language (Python preferably) will help considerably. Any semiconductor physics or materials science knowledge is a plus. Students will work with researchers to gain the understanding necessary to perform their research.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Leslie Hwang	**ECEE**	**Machine learning; Electronic Physical Design and Packaging**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Semiconductor packaging design analysis is a high-dimensional multi-physics problem, creating challenges for efficient computing. For practical optimizations and novel design discovery, deep learning driven methodologies are promising alternatives to numerical analysis but there are challenges to train generalized models for multiphysics problems. **Students will:** There will be two stages in this project. First, the student will use CFD solver to generate and analyze proposed packaging architecture. Then, the student will use existing ML code framework to generate models for simulated designs. **Prerequisite skills/knowledge:** Knowledgeable in Machine Learning, Engineering Mathematics, Computer Programming. Hands-on experience in Python.

Nidhin Kurian Kalarickal	**ECEE**	**Semiconductor devices for RF and power**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: This project will focus on simulation of diamond based static induction transistors for RF and low voltage power switching applications. Diamond is an ultra-wide band gap semiconductor with attractive properties like high breakdown field (~10 MV/cm), high electron and hole mobilities, high saturation velocity and high thermal conductivity. However, the deep donor and acceptor energy levels make it difficult to develop low resistance vertical devices with high current density. In this work we will focus on static induction transistors which makes use of electron injection from the contacts rather than relying on the doped carrier concentrations. This simulation work will utilize TCAD (Silvaco) as well as analytical modeling to estimate the DC and RF characteristics of diamond static induction transistors. **Students will:** Perform simulation and modeling of devices primarily using Silvaco TCAD. Effect of device and epilayer parameters will be analyzed to determine the optimal design enabling high power density and power gain. **Prerequisite skills/knowledge:** Knowledge of semiconductor device physics.

Kexin (Kathy) Li	**ECEE**	**Semiconductor device simulation and modeling**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Simulation of Ferroelectric FET (Fe-FET) for in-memory computing: This project is dedicated to maximizing the utilization of the entire analog memory window of FeFET while maintaining high linearity and symmetry. While ferroelectric FET (FeFET) has found widespread use in various applications like multilevel cells and synaptic weight cells for in-memory computing through the exploitation of analog threshold voltage states, it's crucial to address non-idealities, such as channel percolation. Channel percolation can cause an abrupt threshold voltage jump, significantly limiting the available analog states in FeFET. In this project, the student will employ the Synopsys TCAD-to-SPICE tool Mystic to investigate and assess the impact of transistor design and operation on circuit-level performance metrics. **Students will:** Learn to simulate advanced semiconductor device structure using commercial TCAD solver (Synopsys Sentaurus). **Prerequisite skills/knowledge:** Basic level understanding of semiconductor physics and devices, as well as electronic circuits. Experience with TCAD simulation is a plus but not required.

Kexin (Kathy) Li	**ECEE**	**Semiconductor device simulation and optimization**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Design optimization of Solar-blind photodetector (SBPDs): This project is dedicated to carrying out optimization based on current SBPDs for fast response, high signal-to-noise ratio, and low energy consumption. Owing to a low false alarm rate in SBPDs, they are crucial in military and civil fields, such as missile tracking, flame detection, solar-blind imaging, space communication, and navigational positioning. Candidate wide bandgap semiconductor materials for making SBPDs include AlGaN, MgZnO, Ga2O3, SiC, and diamond. And three-terminal field-effect phototransistors with high photo-response controllability and excellent performance by introducing gate modulation have been proposed to board its application field. In this project, the student will employ the Synopsys TCAD simulation tool to carry out SBPD optimization through simulation with various device design options. **Students will:** Learn to simulate advanced semiconductor device structure using commercial TCAD solver (Synopsys Sentaurus). **Prerequisite skills/knowledge:** Basic level understanding of semiconductor physics and devices, as well as electronic circuits. Experience with TCAD simulation is a plus but not required.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Matthew Marinella	**ECEE**	**Semiconductor devices for AI**	**Tempe**	**U. S. Citizen only**

Project description: This project focuses on developing nonvolatile emerging memory devices for AI and low energy computing. Reducing computing energy is a major goal of the microelectronics field – especially for processing AI algorithms. One leading approach is known as "analog in memory computing," which uses resistive nonvolatile memories to represent weights in a neural network. This project is exploring two leading device candidates: electrochemical memory (ECRAM) and resistive memory (ReRAM) for use in these analog systems. We have developed these devices in ASU and Sandia's fabrication facilities and are electrically studying them to better understand the device physics and use this knowledge to optimize them for analog computing. We are also demonstrating these devices performing neural network processing in small (1024 device), CMOS integrated arrays. **Students will:** The main tasks are to electrically measure and analyze memory devices (ECRAM and ReRAM) on the bench as well as integrated into a CMOS array platform, including writing/editing python code to facilitate these tasks. **Prerequisite skills/knowledge:** Knowledge of semiconductor devices and python are a plus but not required.

Amarsagar Reddy Ramapuram Matavalam	**ECEE**	**Machine learning, Graph neural networks, power systems**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Understand the challenges of applying data science and machine learning to geometric data such as graphs. They will then design and study novel algorithms that interactively and adaptively leverage structure present in the problem. This project has the potential to make fundamental contributions to the application of machine learning to electrical power systems. **Students will:** Interact with PhD students in my research group to implement physics informed ML models using frameworks such as TensorFlow, Pytorch, Jax or in Julia. **Prerequisite skills/knowledge:** An ideal student will have background in using Pytorch/TensorFlow/Julia, minimal knowledge of electric power systems and data science methods.

Amarsagar Reddy Ramapuram Matavalam	**ECEE**	**Machine learning, dynamical systems, power systems**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Understand the basics of differential equations and how to simulate them. They will then apply existing code in Pytorch/TensorFlow/Jax to apply it to differential equations corresponding to power systems. This project has the potential to become a long-term research topic in applying neural ODEs to power grids. **Students will:** Interact with PhD students in my research group to implement physics informed ML models for simulating large dynamical systems using frameworks such as TensorFlow, Pytorch, Jax or Julia. **Prerequisite skills/knowledge:** An ideal student will have background in using Pytorch/TensorFlow/Julia, minimal knowledge of electric power systems and data science methods.

Mike Ranjram	**ECEE**	**Power Electronics, Power Magnetics, Miniaturized Power Conversion**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Magnetic components (inductors and transformers) bottleneck the size, weight, and loss of many power electronic converters. A critical avenue towards mitigating this bottleneck is to better understand the core loss characteristics of these materials. Core loss is nonlinear and so must be tested under real world or "large signal" operating conditions. In this project, the student will be part of a team developing new power electronic hardware that is capable of characterizing magnetic core loss in the 1-50MHz regime. **Students will:** Assist or take the lead on designing the core loss tester, developing new printed circuit board for new tester prototypes, soldering these prototypes, testing new magnetic materials using the developed hardware, and developing software to automate this testing. **Prerequisite skills/knowledge:** Students must have a strong background in circuit analysis. Ideally, already completed a course in power electronics and have experience with PCB layout software such as Altium.

Mike Ranjram	**ECEE**	**Power Electronics, Power Magnetics, Miniaturized Power Conversion**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Hydrogen derived from renewable energy sources, called "green hydrogen", is a compelling path towards decarbonization. There are many important challenges to be solved. Our group works on power electronic converters and systems which are required to interface large scale renewable energy production (e.g., from wind) to large scale hydrogen electrolyzers. These systems should be as low cost and efficient as possible. In this project, students will assist with the development of an electrolysis demonstration unit that illustrates the utility of power electronics in these systems. This includes the creation of custom power electronics hardware. **Students will:** Assist or take the lead on specifying the hydrogen electrolysis demonstration system, devising power electronics demonstrations for this system, and assisting with the advancement of emerging concepts being developed in our research group for these systems. **Prerequisite skills/knowledge:** Students must have a good background in circuit analysis. Ideally, the student will have already completed a course in power electronics and have experience with PCB layout software such as Altium.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Nick Rolston	**ECEE**	**Renewable Energy Materials and Devices; Photovoltaics**	**Research Park**	**U. S. Citizen or non-U. S. Citizen**

Project description: Atmospheric pressure or open-air plasmas can be directly integrated with in-line production. We have focused on using spray coating as a technique for liquid precursor delivery of numerous types of materials. We have shown that stoichiometry, composition, growth rate, density, and defectivity can be controlled through this process for chemistries such as silica, titania, tin oxide, and perovskites without additional annealing to form high-quality, scalable device layers. There is also a clear path for transparent conducting oxides, semiconducting charge transport layers, battery electrode materials, and even tandem module fabrication. This project will focus on the processing of scalable perovskite thin films and associated charge transport layers in open-air with improved operational and mechanical properties for a path toward commercializing this next-generation photovoltaic technology. **Students will:** Learn how to make photovoltaic materials and devices from solution using scalable printing processes and characterize them with mechanical and optoelectronic measurements. **Prerequisite skills/knowledge:** Knowledge of materials science and mechanical properties is a plus although not required.

Nick Rolston	**ECEE**	**Renewable Energy Materials and Devices; Batteries**	**Research Park**	**U. S. Citizen or non-U. S. Citizen**

Project description: A compelling opportunity for higher energy density batteries is solid-state electrolytes (SSEs), which offer a host of advantages over the liquid electrolytes that dominate the market today: they are leak-proof, energy-dense, flame-resistant, contain no toxic organic solvents, and can charge faster. A challenge to the commercialization of solid-state batteries is the development of a stable SSE that can support the film stresses that develop from significant expansion during cycling and can be processed with low-cost manufacturing processes. The objective of this work is to two-fold: to improve the thermomechanical reliability of SSEs and to subsequently produce safe, durable, and high-specific energy solid state batteries with a robust thin film SSE. The overarching questions that will be investigated are the material (ionic and electronic conductivity) from thin-film processing of ceramic-based SSEs and mechanical properties that develop in SSEs for understanding of chemomechanical degradation modes. **Students will:** Learn how to make battery materials and devices from solution using printing processes and characterize them with electronic and ionic conductivity measurements. **Prerequisite skills/knowledge:** Knowledge of electrochemistry, materials science, and mechanical properties is a plus (although not required).

Lalitha Sankar	**ECEE**	**Designs of private, fair, and robust ML algorithms and reliable generative models**	**Tempe**	**U. S. Citizen only**

Project description: Project at the intersection of privacy, fairness, and generative models**. Students will:** Learn to evaluate and enhance generative models with privacy guarantees**. Prerequisite skills/knowledge:** Basic understanding of machine learning algorithms essential; interest in programming AND mathematics crucial.

Chao Wang	**ECEE**	**Additive manufacturing of metal microstructures**	**Tempe**	**U. S. Citizen only**

Project description: The objective of the research is to develop a versatile technique that is capable of printing metallic structures at micrometer- and nanometer-scale resolution feasible for electronic and photonic applications. Here we will explore a new solution-based photochemically induced polymer-assisted deposition (PIPAD) process to scalably produce thickness- and dimension-controlled, highly reflective and highly conductive metal microstructures. **Students will:** Be trained on our metal printing setup, as well as photolithography and characterization tools within the lab. **Prerequisite skills/knowledge:** This project is open to only Junior and Senior students majoring in electrical engineering, material science, or chemical engineering.

Chao Wang	**ECEE**	**Circuit design for accessible healthcare**	**Tempe**	**U. S. Citizen only**

Project description: The objective of the research is to develop a portable electronic detector (PED) system that will be suitable for accessible healthcare use. The PED system will analyze signals from biomarker detection, and store, process, transmit and display the signals. The goal is to make the system suitable for use for those inexperienced users, which will have significant impact on broadening healthcare in resource-limited areas. **Students will:** Work with a multidisciplinary team to develop new electronic devices for signal collection, processing, and display. **Prerequisite skills/knowledge:** This project is open to only Junior and Senior students majoring in electrical engineering. Circuit (analog or digital) design and/or hardware programming skills are desired.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Jeff Zhang	**ECEE**	**Computer Architecture, AI/ML Hardware and System, Energy-efficient Computing**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: HW/SW codesign to enable efficient acceleration of emerging applications (e.g., ML models) on reconfigurable accelerators. Coarse-grained reconfigurable accelerator (CGRA) is a promising alternative for power-efficient acceleration compared with GPU, FPGA, ASIC, etc. How to map an application kernel onto CGRA significantly impacts the speedup. Therefore, a framework including a mapper with scalability and a verification/simulation mechanism for guaranteeing the mapping correctness is in demand. **Students will:** Optimize the existing CGRA mapping framework to improve the scalability; Integrate the mapping framework with the simulator; Improve the GUI for mapping demonstration. **Prerequisite skills/knowledge:** C++, Python. Courses: Computer Architecture, Data Structure, Algorithms.

School for Engineering of Matter, Transport and Energy (SEMTE)

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Bhavik Bakshi	**SEMTE**	**Sustainable engineering: Process systems engineering**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Most corporations have pledged to attain net-zero greenhouse gas emissions within the next few decades. However, the path to meeting this pledge is far from clear and meeting this goal in an economically feasible manner can be very challenging. There is a need for systematic methods and tools to guide industry transition to net-zero emissions in an economically feasible and socially desirable manner. This requires systematic methods that consider not just the manufacturing process but all the upstream and downstream processes, that is the full life cycle of the product. The best combination of renewable resources, chemical recycling methods and carbon capture, utilization, and storage needs to be determined for hundreds of chemicals and their products. **Students will:** Focus on a specific product or class of materials and understand their current manufacturing, cost, and life cycle environmental impact. They will identify alternatives to develop future processes with net-zero greenhouse gas emissions in the life cycle. Trade-off between cost and emissions will be evaluated to determine the "best" solution. **Prerequisite skills/knowledge:** Basic knowledge of mass and energy balances and first and second laws of thermodynamics.

Candace Chan	**SEMTE**	**Electrochemical Energy Storage**	**Tempe**	**U. S. Citizen only**

Project description: This project focuses on the development of all-solid-state lithium batteries. The research will involve preparation of ceramic solid electrolyte materials using different synthetic processes, carrying out materials characterization to understand the obtained structure and composition, and evaluation of electrochemical properties. **Students will:** Gain experience on materials synthesis, materials characterization tools such as X-ray diffraction and various spectroscopies, skills in ceramics processing and battery fabrication and testing, and experience in data analysis related to materials characterization and electrochemical testing. **Prerequisite skills/knowledge:** Students with previous chemistry lab experience and course work in materials science, chemistry, and/or chemical engineering are preferred but not required.

Aditi Chattopadhyay	**SEMTE**	**Investigation of Multifunctional Smart Material**	**Tempe**	**U. S. Citizen only**

Project description: Project focused on developing novel multifunctional shape memory composites with improved mechanical, electrical, and thermal properties for Naval applications. Utilizing design of experiments to characterize the properties of these novel nanofiller-enhanced multifunctional composite laminates. **Students will:** Prepare standardized specimens of synthesized shape memory laminates and assist in performing microscopy (optical and SEM) and mechanical testing. **Prerequisite skills/knowledge:** Junior or senior undergraduate students from mechanical or aerospace engineering; some background in mechanics of materials is a plus.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Aditi Chattopadhyay	**SEMTE**	**Structural Health Monitoring in Advanced Composites**	**Tempe**	**U. S. Citizen only**

Project description: Project focused on structural health monitoring (SHM) in advanced polymer composites and structures using piezoelectric devices and gain insight into utilizing guided waves for damage detection. Utilize non-destructive evaluation (NDE) techniques to characterize laminate damage. **Students will:** Prepare sandwich composite laminate with various induced damages and conduct SHM, & NDE testing. **Prerequisite skills/knowledge:** Junior or senior undergraduate students from mechanical or aerospace engineering; some background in mechanics of materials is a plus.

Wanxin Jin	**SEMTE**	**Robotics, Robot learning**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Diffusion and energy-based models, as the backbone of generative AI, arguably achieve tremendous success. This motivates us to explore its potential in the domain of robot planning, control, and more general robot decision-making. The objective of research is to bridge the connection of those models with counterparts in traditional robot control and planning, and develop scalable data-driven algorithm for advanced robot control and planning. **Students will:** Explore the use of diffusion or energy-based models to develop new algorithms for robot learning from demonstrations, detecting out-of-the-distribution data, and robot optimal control (model predictive control) **Prerequisite skills/knowledge:** Students are expected to have the knowledge of optimization, optimal control, machine learning, and probabilistic theory. Also, students are expected to be very familiar with python programming with different machine learning frameworks such as PyTorch and some robotics simulator such as MuJoCo, Pybullet.

Cindy (Xiangjia) Li	**SEMTE**	**3D printing; biomimetic design; interfacial engineering**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Underwater air retaining surfaces have shown wide applications, include drag reduction and thermal insulation. But the problem so far has been the air retaining stability of superhydrophobic surfaces. The air layer volume of current superhydrophobic surfaces is limited, and air layers last only a few minutes to hours in the turbulent flow. Hence, the research for fabricating bioinspired structures with stable and large volume air retaining is necessary and challenging. During this summer internship, the students will work with graduate students to learn about the volume and stability of the air layer generated by ISA-3D printed bioinspired structures in term of time, pressure, and turbulent flow, and the drag reduction of ISA-3D printed bioinspired structures will also be explored. **Students will:** Have the flexibility to choose tasks that align with their personal interests. The research opportunities available encompass the following areas: (1) Analyzing air layer volume and its sustained air-holding capacity. (2) Examining the stability of air layers. (3) Assessing the potential for drag reduction. (4) Conducting tests on the newly developed ISA-3D printed eggbeater-shaped structures, which have potential applications in transportation, micro robotics, and thermal insulation. **Prerequisite skills/knowledge:** Familiarity with computer-aided design and fabrication is advantageous, though not mandatory.

Jian Li	**SEMTE**	**Flexible Electronics**	**ASU Research Park**	**U. S. Citizen or non-U. S. Citizen**

Project description: The project is to understand the current status of OLED materials technology and how to optimize them for high current density OLED driving conditions. **Students will:** Be in the laboratory fabricating, characterizing and testing organic semiconductor devices. **Prerequisite skills/knowledge:** The students should have some expertise and knowledge in semiconductor device and physics.

Jerry Lin	**SEMTE**	**Ion transport in zeolite micropores**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Ion transport in zeolite pores. **Students will:** Learn how to make zeolites, study solvent-zeolite interaction and ion transport in the pores.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Gokul Pathikonda	**SEMTE**	**Experimental Aerodynamics**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: The goal of the project is to design and characterize an experimental system capable of imposing an arbitrary pressure gradient within a wind-tunnel. This is achieved via wall transpiration using suction and blowing on the top-wall of the boundary layer wind-tunnel. The project includes the design and implementation of the control system and characterizing the performance of the system designed using an array of wall pressure transducers. **Students will:** Be designing and constructing an array of computer-controlled fans to be mounted on top of the wind-tunnel. The student also designs the control system and tests the performance of the system using an array of wall-pressure transducers. The student is also required to document the performance characteristics and the operation of the entire system. **Prerequisite skills/knowledge:** The students are required to have prior programming experience (MATLAB/Python), a basic understanding of incompressible fluid flows, experience in building electronic circuits, measure voltages/currents, and have familiarity with microcontrollers (Arduino, Raspberry Pi, etc.).

Pat Phelan	SEMTE	Thermal engineering	Tempe	U. S. Citizen or non-U. S. Citizen

Project description: This project involves identifying energy-efficient solutions for manufacturers and other clients. An associated research project will focus on the analysis of electricity data and how that can be used to identify energy savings.

Jeffrey Self	SEMTE	Polymer foams; 3D printing; Photochemistry	Tempe	U. S. Citizen or non-U. S. Citizen

Project description: Polymer foams play a critical role in a range of technologies, including protective/safety equipment, thermal insulation, purification/separation, and others. Currently, the production of foams is limited in scope of materials and lack of control over the resulting microstructure. Polymerizable high internal phase emulsion (polyHIPE) is a recent innovation that allows for the production of complex foam parts, but with many of the same limitations (materials scope and microstructural control). It is anticipated that the integration of photo-responsive chemical groups in the surfactant design could allow for “smart” surfactants that change polarity upon light irradiation. Integration of these photo-responsive surfactants into polyHIPE systems could provide a tool for locally controlling pore morphology in the resulting polymer foam. During this summer internship, the students will work with graduate students to learn about the development and characterization of these materials. **Students will:** This project has many different components that students can work on, depending on their own interests (e.g., synthesis development versus materials characterization). These components include: i) synthesizing polarity-switching surfactants, ii) using UV-vis and other spectroscopic methods to characterize the photo-responsive behavior, iii) developing a polymerization system for the external phase, and iv) exploring the feasibly of 3D printing these materials by studying their flow properties via rheology. **Prerequisite skills/knowledge:** Knowledge of synthesis and methods is a plus, but not required.

Sandhya Susarla	SEMTE	Semiconducting materials	Tempe	U. S. Citizen or non-U. S. Citizen

Project description: The development of low-power microelectronic devices, quantum computers, and data storage is driven by how the atoms are bonded to one another and their corresponding atomic scale electronic interactions. Transmission electron microscopy and spectroscopy is the most commonly used metrology to image and probe electronic and magnetic interactions. However, the primary challenge for this characterization is sample preparation. During this summer internship, the students will primarily learn to prepare electron transparent sample via mechanical polishing and stamping techniques. Successful optimization of the transfer techniques will result in unique electron microscopy experiments to image spin textures, polarization domains, atomic vibrations, defects, and strain at the buried interfaces in the future**. Students will:** Learn how to fabricate TEM samples, simulate images and understand diffraction patterns. **Prerequisite skills/knowledge:** Knowledge about materials science, condensed matter physics and inorganic chemistry (although not required).

Jiefeng Sun	SEMTE	Robotics; Mechatronics	Tempe	U. S. Citizen or non-U. S. Citizen

Project description: A Soft Worm-like Jumping Robot driven by Artificial Muscles: Jumping is often achieved through the use of propulsive legs, but it's noteworthy that legless leaping has evolved independently on multiple occasions. This project's objective is to develop a worm-like soft jumping robot powered by a twisted-and-coiled actuator (TCA), drawing inspiration from the legless larvae of gall midges known for their impressive long-distance jumping abilities. To achieve this goal, the student will commence by acquiring the skills to fabricate TCAs. Subsequently, the focus will shift towards studying the energy-conversion efficiency and actuation speed of TCAs under various voltage input conditions. Following the design and optimization of TCA geometry and control mechanisms, our ultimate aim is to create autonomous, legless, soft jumpers capable of continuous jumping. **Students will:** Learn to fabricate artificial muscles and create soft robots. The student will characterize the artificial muscle and prototype the soft jumping robot. **Prerequisite skills/knowledge:** Knowledge of mechatronics, Arduino programing, and FEA.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Jiefeng Sun	**SEMTE**	**Robotics; Dynamics System; Control**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Simulation of Locomotion for Artificial-muscle-driven Robots: The aim of this project is to simulate the locomotion of robots powered by artificial muscles, such as jumping and walking. Despite the rapid advancement of artificial muscle-driven robots, the development of modeling and simulation has not kept pace. In this project, the student will incorporate an existing artificial-muscle model into a robot to create physics-based models for both rigid, soft, and hybrid robots, simulate their movements, and assess their locomotion across various terrains. Moreover, muscle routing optimization will be undertaken to streamline the design process for different character morphologies based on the model. **Students will:** Study the physics-based simulation methods, derive models, and implement the simulation with python/C++. **Prerequisite skills/knowledge:** Knowledge of solid mechanics, dynamic systems, and numerical methods (ODE/PDE solvers). Proficient in one programming language: Python/C++.

Sui Yang	**SEMTE**	**Nanophotonics and Energy**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: The project seeks to develop novel nanophotonic film for energy applications. The film will consist of nanoparticles and polymers made by 3D printing and self-assembly. This novel film will feature both enhanced mechanical properties and photonic characteristics for light (solar) energy harvesting and conversion. **Students will:** Work with a graduate researcher in optical designing, synthesis and characterization of the nanoparticle film, as well as learning the optics techniques. **Prerequisite skills/knowledge:** Course taken in Physics and Chemistry field, preferred Solid State Physics, Inorganic Chemistry.

School of Biological & Health Systems Engineering

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Madeline Andrews	**SBHSE**	**Regenerative Medicine, stem cell models, neurological disease, tissue engineering**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: Determine optimal culture conditions for human pluripotent stem cell (PSC)-derived neuronal populations during cortical development. By defining appropriate culture conditions, we can better model features of the human brain and disease. As current neural organoid culture methods have significant metabolic limitations leading to impairments in specification and maturation, this project will evaluate the consequence of altering oxygen levels to more closely mimic endogenous brain development. **Students will:** Learn how to culture PSC lines along a differentiation trajectory to produce 3D neural organoids. PSC lines will be cultured in different oxygen conditions of either 4%, 8% or 20% O2 consistently or gradually transitioned into higher oxygen conditions. After different culture paradigms, cortical organoid-derived cells will be evaluated to determine the impact on gene expression. The student will learn engineering approaches for how to culture and analyze human cell types to more accurately study human brain development with application toward a range of neurological diseases. **Prerequisite skills/knowledge:** Basic molecular biology background knowledge and experience using pipettes. Cell culture experience is a bonus.

Sarah Stabenfeldt	**SBHSE**	**Biomaterials, nanoparticles, neurotrauma**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: This project focuses on developing novel nanoparticle-based therapeutics for traumatic brain injury. **Students will:** Be in the laboratory fabricating nanoparticle systems, characterizing drug release, and/or assessing therapeutic response in preclinical mouse models. The student will need to complete laboratory safety trainings and open to animal research. **Prerequisite skills/knowledge:** No specific knowledge required - a willingness to learn molecular laboratory techniques, polymer fabrication, and animal research.

Kuei-Chun (Mark) Wang	**SBHSE**	**Biomaterials, nanomedicine, inflammatory diseases**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: The objective of this project is to develop biomimetic nanoparticles for the delivery of RNA-based therapeutics to target inflammatory diseases. **Students will:** Work with PhD students in the lab to prepare and characterize the nanoparticles and assess their biocompatibility using cell culture models. **Prerequisite skills/knowledge:** Experience in cell culture and/or molecular cloning experiments.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Jessica Weaver	**SBHSE**	**Biomaterials, tissue engineering, immune engineering**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: This project is centered on hydrogel injection molding technology and its application in encapsulated cell therapy to treat type 1 diabetes. **Students will:** Learn how to injection mold hydrogels to generate complex macroencapsulation device geometries, assist in engineering an automated method to generate these hydrogels, and time permitting learn biomaterial fabrication, cell culture, and histological techniques. **Prerequisite skills/knowledge:** Knowledge of hydrogels, cell culture, and histological techniques a plus but not required.

School of Computing and Augmented Intelligence (SCAI)

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Yoo Jung Choi	**SCAI**	**Machine learning, Algorithmic fairness**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: This project focuses on studying the effects of distribution shifts on fairness of machine learning models and developing ML methods with fairness guarantees that are robust under various distribution shifts. An important task for deploying ML systems is to ensure that AI/ML-based or -assisted decisions do not cause disproportionate harmful effects, which is often made more challenging by differing distributions at train and test time. Our group has developed probabilistic modeling-based methods to audit and ensure fairness of classifiers in the presence of label bias/shift. We will conduct experiments to thoroughly analyze the method for various notions of fairness and extend it to also be able to handle covariate shifts. **Students will:** Read relevant literature and gather benchmarks; design, implement, and test fairness-aware learning methods under various distribution shifts. **Prerequisite skills/knowledge:** Knowledge of Python, basic AI/ML methods and probability; Familiarity with Julia preferred but not required.

YooJung Choi	**SCAI**	**Machine learning, generative AI**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: This project aims to extend pre-trained generative models on a particular modality to be able to perform conditional or cross-modal generation: for example, generate images of one style from another style of input, or image from text and vice versa. We will explore modeling the dependencies between the joint latent space of pre-trained models. If time permits, we will explore generating explanations and/or injecting knowledge/constraints. **Students will:** Be responsible for implementing the training and generation pipeline, collecting/synthesizing multimodal datasets, and running empirical evaluation. **Prerequisite skills/knowledge:** Basic knowledge of AI/ML, Python programming skills, and familiarity with ML libraries (e.g. PyTorch).

Rakibul Hasan	**SCAI**	**Security and privacy**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: In this project, we will investigate security and privacy vulnerabilities of educational technologies, such as google classroom and canvas, and educational marketplaces, such as zoom marketplace. **Students will:** Learn and apply security and privacy auditing systems, application analysis, statistical analysis, etc. Should have good programming knowledge.

Rong Pan	**SCAI**	**Digital twins of distributed manufacturing systems, use AI to develop digitial twins**	**Tempe**	**U. S. Citizen only**

Project description: The project is about creating a 3D printing simulation model, either on the production system level or on the manufacturing process level, as the digital twin of the actual system. **Students will:** Study discrete-event simulation for simulating a production system, or study physics-informed neural networks for process simulation. **Prerequisite skills/knowledge:** Know how to program in Python, have basic knowledge of system simulation, or PDEs in fluid dynamic.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Minseok Ryu	**SCAI**	**Machine learning for stochastic and robust multi-stage optimization**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: In this project, we will study how the machine learning techniques can be utilized for accelerating algorithms for solving stochastic and robust multi-stage optimization problems, especially when integer variables exist at later stages. **Students will:** Be expected to (i) Read and understand the relevant literature, (ii) Reproduce the existing work, (iii) Develop and implement machine-learning based optimization algorithms. **Prerequisite skills/knowledge:** Knowledge of Python, PyTorch, Julia, JuMP, Gurobi, and/or CPLEX.

Minseok Ryu	**SCAI**	**Anomaly Detection in Power Systems via Vertical Federated Learning**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: In this project, we will study how to utilize the vertical federated learning technique for training machine learning model without centralizing data, which will be used for real-time anomaly detection in power system. **Students will:** Be expected to (i) read and understand the relevant literature, (ii) reproduce the existing work, (iii) implement vertical federated learning framework for the anomaly detection. **Prerequisite skills/knowledge:** Knowledge of Python, PyTorch, Julia, JuMP, Gurobi, and/or CPLEX.

Yan Shoshitaishvili	**SCAI**	**Cybersecurity**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: The project will explore novel cybersecurity issues in real-world software and systems. Project phases will include the analysis of both source code and compiled binaries for vulnerabilities and, once vulnerabilities are identified, the creation of Proof of Concept exploits to demonstrate the severity of each flaw. This information will be responsibly disclosed to software authors for remediation. **Students will:** Develop tools to analyze software and then manually analyze the results of those tools. **Prerequisite skills/knowledge:** Should have expertise in software security and program analysis. The concepts taught by https://pwn.college are well-aligned with this project.

Hao Yan	**SCAI**	**Machine Learning; Physical Simulation**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: The goal of this project is to develop a machine learning meta model for optimizing reactor design through machine learning and Bayesian Optimization. Leveraging the Virtual Test Bed repository of the National Reactor Innovation Center, we will develop two primary test cases: one focused on a heat-pipe micro reactor and another on a Pebble Bed Modular Reactor. These test cases will involve the modification of a comprehensive set of design parameters and will leverage multiphysics simulations for performance evaluation. **Students will:** Collaborate closely with the research team at Dr. Yan's lab, primarily focusing on the development and optimization of nuclear reactor design methodologies. Their main tasks will include contributing to the creation of simulation test cases based on the Virtual Test Bed repository and the implementation of Bayesian Optimization (BO) algorithms. The students will engage in multiphysics simulation activities, alongside learning specialized software toolchains and design parameter variation techniques that are pivotal to the project's success. Additionally, they will be involved in applying artificial intelligence (AI) methods to adaptively and intelligently select design parameters for ensuring optimized reactor design outcomes. This exposure will not only provide them with hands-on experience in complex system optimization but also integrate them into cutting-edge research that aims to revolutionize reactor design methodologies. **Prerequisite skills/knowledge:** Knowledge of Python and Pytorch, Linux/Ubuntu.

Hao Yan	**SCAI**	**Machine Learning; Natural Language Processing**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: In this research project, we aim to harness the computational power of advanced language models, specifically GPT-3, GPT-4, and ChatGPT, to explore causal relationships among events. The project has two primary objectives: first, we seek to investigate the most effective techniques for prompt-based learning that can facilitate efficient causal discovery from these language models; second, we plan to develop a system that utilizes a sequence of carefully designed prompts to guide the language model in identifying and elucidating causal factors underlying various events. To empirically validate our methodologies, we will conduct experiments on two substantive datasets: the National Transportation Safety Board (NTSB) Aviation Accident Reports, which provide in-depth analyses of aviation accidents, and the Pipeline and Hazardous Materials Safety Administration (PHMSA) Pipeline Accident Reports, another rich resource that can yield insights into causal relationships. Both datasets offer diverse and complex scenarios that are crucial for testing the efficacy of our proposed text-based causal learning techniques. **Students will:** Work closely with the research team in my lab, focusing on leveraging advanced language models like GPT-3, GPT-4, and ChatGPT for causal relationship discovery among events. Their primary responsibilities will encompass the development of effective prompt-learning techniques for efficient causal identification, as well as the formulation of sequential prompting systems designed to guide the language models in causal discovery. Students will also be responsible for validating these methodologies through rigorous empirical testing on two critical datasets: the NTSB Aviation Accident Reports and the PHMSA Pipeline Accident Reports. **Prerequisite skills/knowledge:** Knowledge of Python, OpenAI GPT API (Recommended).

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Ming Zhao	**SCAI**	**Edge computing and machine learning**	**Tempe**	**U. S. Citizen only**

Project description: Study machine learning applications on Internet of Things data and edge computing resources. **Prerequisite skills/knowledge:** Knowledgeable with machine learning and proficient in programming.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Ming Zhao	**SCAI**	**Emerging memory/storage systems**	**Tempe**	**U. S. Citizen only**

Project description: Study the memory/storage systems using emerging new technologies. **Prerequisite skills/knowledge:** Knowledgeable with computer systems and proficient in programming.

School of Manufacturing Systems and Networks

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Xiangyang Dong	**Other**	**Soft robotics, Multifunctional composites, Additive Manufacturing**	**Polytechnic**	**U. S. Citizen or non-U. S. Citizen**

Project description: Current state-of-the-art soft robots are often tethered to bulky control and external power systems, making it challenging for autonomy. The implementation of the energy-storage system is the most critical limitation to robot autonomy, due to the requirement of a constant supply of external power to maintain deformation. One alternative way toward this end is to use deformable energy storage system that will serve not only as an energy storage system to power the soft robots but also as an integrated actuator to drive the deformation of the soft robot body. The objective of this project is to develop advanced electrochemical actuators and control capability for soft robots that can simultaneously achieve energy storage, load bearing, and shape morphing. **Students will:** Use 3D printing methods to design, fabricate, and test lightweight multifunctional composites. The research goal is to establish a fundamental understanding of coupled relationship between electrochemical, mechanical, and robotic performance for a self-powered untethered soft robotic system. **Prerequisite skills/knowledge:** Knowledge of mechanics, electrochemistry, or manufacturing; experiences of using Python is a plus. Students with previous chemistry and biology experience, including experience with working with microorganisms.

Luminosity Lab

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Mark Naufel	**Other**	**The Luminosity Lab**	**Tempe**	**U. S. Citizen only**

Project description: Work alongside ASU's premier R&D Lab, Luminosity, on either an existing project they are already working on their campus or be put on one of the Lab's ongoing projects. **Students will:** Work on interdisciplinary teams through the ideation, research, prototyping, testing, and ongoing development of one of Luminosity's active projects. Students will complete projects utilizing the agile approach to project management and will work on projects related to field such as robotics/technology, community development, software, or space exploration. **Prerequisite skills/knowledge:** Students with experience working on interdisciplinary teams, specifically those with experience in Luminosity (preferred but not required).

School of Sustainable Engineering and the Built Environment (SSEBE)

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Anca Delgado	**SSEBE**	**Environmental engineering, bioremediation and bioweathering**	**Tempe**	**U. S. Citizen only**

Project description: The objective of this project is to assess the bioweathering potential of Martian regolith simulant to be converted into a soil-like material amenable for plant growth. Perchlorate salt is a major component of Martian regolith and perchlorate removal is a requirement to promote plant growth and protect human health. The project utilizes microorganisms to reduce perchlorate and bioweather the regolith simulant. **Students will:** Learn how to culture perchlorate-reducing bacteria, setup microcosms with Martian regolith simulant, measure microbial activity, and characterize the regolith bioweathering with a variety of techniques. **Prerequisite skills/knowledge:** Students with previous chemistry and biology experience, including experience with working with microorganisms.

Ricardo Eiris	SSEBE	Virtual Reality; Drones; STEM Learning	Tempe	U. S. Citizen or non-U. S. Citizen

Project description: Academic disciplines in science, technology, engineering, and mathematics (STEM) require direct observation and interpretation of complex spaces to enable effective communication of ideas between professionals. Field trips are one of the most common methods used to deliver these opportunities for situated learning experiences, engaging students in active learning, assisting traditional lessons, and supporting deeper learning of spatial, verbal, and math abilities. However, STEM field trips present major logistical, financial, and accessibility implementation challenges for educational institutions and instructors that have hindered the use of field trips in classrooms. This project will focus on using new drone technologies in combination with virtual reality techniques to create real-time, multiuser field trips experiences through web interfaces. While these field trips will be available to all STEM disciplines, this project will be focused on construction engineering and management field trips for student learning. **Students will:** Learn how to develop virtual reality experiences using game engines, connect real-time data from drones to virtual experiences, and deploy interactive web interfaces. **Prerequisite skills/knowledge:** Knowledge in computer programing (C++/C#). Knowledge or experience with virtual reality (Unity), drones, or construction engineering and management is a plus although not required.

Margaret Garcia	SSEBE	Water resources engineering, water systems modeling	Tempe	U. S. Citizen or non-U. S. Citizen

Project description: The objective of this project is to assess the reliability of the regional water supply system in the Western US which spans the Colorado River Basin and other interconnected river basins such as the Rio Grande. A key question is how the system performs under alternative spatial and temporal patterns of hydroclimatic variability and change, and how alternate operating policies influence the balance between local and system risk. **Students will:** Assist in the development of a regional water supply systems model, testing the model performance against historic observations, applying the model to assess system performance against plausible hydroclimatic scenarios, and developing alternate operating policies to increase system robustness. **Prerequisite skills/knowledge:** The project is open to upper-level students in Civil or Environmental Engineering who have taken fluid mechanics and hydrology or equivalent courses.

Emmanuel Salifu	SSEBE	Biogeotechnical Engineering; Environmental Biotechnology; Biomaterials	Tempe	U. S. Citizen or non-U. S. Citizen

Project description: This project seeks to optimize the method for mycelium growth towards the rapid production of mycelial biomass, biosurfactants, and bio-composites deployable for the modification of soil properties. We aim to explore the effect of these mycelium-derived materials/products on soil health, quality, and hydromechanical behavior. **Students will:** Be trained and supported to conduct literature review, design experiments, use an IoT-enabled modular bioreactor with real-time remote monitoring to optimize mycelium growth, set up soil microcosms and treat with mycelium, perform soil testing and analysis, and report their findings. **Prerequisite skills/knowledge:** This project is open to seniors or master's students in Civil or Environmental Engineering, with knowledge or interest in microbial culture, materials characterization, and soil science/geotechnical engineering testing methods.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Ravi Yellavajjala	**SSEBE**	**Metal Additive manufacturing and coatings**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: This project will focus on employing metallic coatings to improve the surface properties of metal additive manufactured components. Components that mimic the geometric complexities leading to stress concentrations will be printed and will be subsequently coated. The surface characteristics such as roughness will then be correlated to the fatigue life and corrosion resistance. Various coating and metal additive manufacturing parameters will be explored to achieve desirable results. **Students will:** Be paired with a graduate student and will be involved with microstructural and surface characterization of coated and uncoated metal AM components. **Prerequisite skills/knowledge:** Experience in material science, metallurgy, additive manufacturing is desirable but not necessary.

Ruije Zeng	**SSEBE**	**Machine learning and remote sensing for water resource management**	**Tempe**	**U. S. Citizen or non-U. S. Citizen**

Project description: The project seeks to develop novel machine learning models to process remote sensing images for water resources management and hydrologic simulation. The project will compile remote sensing products from various sources including satellites and drones, and extract the land surface features (e.g., vegetation, temperature, land uses) using machine learning based object detection methods. The derived information will be fed into hydrologic models to guide water resources management. **Students will:** Work with a graduate researcher in data compiling and image processing in Google Earth Engine platform. **Prerequisite skills/knowledge:** Preferred knowledge in remote sensing, geographic information system, hydrology, and machine learning. Programming experiences in Python, Google Earth Engine is preferred.

The Polytechnic School (TPS)

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Zhicheng Guo	**TPS**	**Power Electronics, Clean Energy**	**Polytechnic**	**U. S. Citizen or non-U. S. Citizen**

Project description: The research project targets to develop key components of solid-state transformer (SST) for clean energy and electric vehicle (EV) fast charger applications. SST is an advanced power electronics technology to replace the bulky conventional low-frequency transformer. From hardware design point of view, semiconductor devices/power module and high-frequency transformer (HFT) are two key components. (1) Combining the semiconductor technology and materials science to achieve better insulation/thermal performance of a >1.2 kV SiC/GaN intelligent power module; (2) Optimization of a 10-kW high-frequency transformer with high insulation capacity (> 10 kV) to achieve high power density and good thermal performance. Integrating machine learning and 3D printing technology with magnetic components design. **Students will:** Work closely with the research team in the power electronics and magnetics lab. One student will work on the HFT design which will start with magnetic/thermal/insulation simulations by using Ansys Maxwell. Then build a HFT prototype with 3D printed bobbin. Another student will work on SiC/GaN intelligent power module design which will start with PCB layout and double pulse tests to verify the performances. **Prerequisite skills/knowledge:** Knowledge of power electronics and basic hand-on experience are preferred.

Heejin Jeong	**TPS**	**Human-robot collaboration, Robotics, Teleoperation**	**Polytechnic**	**U. S. Citizen or non-U. S. Citizen**

Project description: This project explores the opportunities and challenges of human collaboration with teleoperated robots within a virtual reality environment. It involves implementing real-world scenarios that utilize VR-assisted human-robot collaboration to assess teamwork, human physiological status, task efficiency, and analyze technical challenges. **Students will:** The primary duties include experimental prototype development (using a mobile humanoid teleoperation robot and VR headset), experimental design and data collection (e.g., online survey, video, and physiological data), and data analysis (e.g., statistical analysis, machine/deep learning). Students will also help write Institutional Review Board (IRB) documents and/or academic publications. The work assignment will be flexible depending on their interests and capabilities. **Prerequisite skills/knowledge:** Skills and experience in programming for robotics and VR development (e.g., Python, ROS, Linux/Ubuntu, Unity, C#) are required.

Faculty Name	FSE	Program/Expertise Area	Campus/ Worksite	Student Eligibility
Ayan Mallik	**TPS**	**Power Electronics**	**Polytechnic**	**U. S. Citizen or non-U. S. Citizen**

Project description: Simultaneous charging of high voltage (HV) traction and low voltage (LV) auxiliary batteries in an electric vehicle (EV) is critical to ensure the feasibility of charging process when the LV battery is depleted and not able to kickstart the HV charging process, and also to enhance the flexibility of charging power flow. One of our research projects deals with conversion of 400V dc link to 600V-rated HV battery and 28V-rated LV battery voltages. @15kW in a heavy-duty vehicle architecture using an "integrated three-port onboard charger", instead of the conventional approach of two separate charging units. This is enabled by a wide bandgap (WBG) semiconductor based three-port CLLC dc-dc resonant converter topology, alongside advanced control and switching modulation schemes. The summer interns will be working closely with the graduate students in this project, primarily to contribute towards the power stage design optimization and control of the power converter system. The students will work on the converter simulation, alongside learning PCB design and control logic programming tasks that are integral part of the project execution. Another focus area of this research would be artificial intelligence (AI)-enabled parameter-invariant control & optimization for long-term optimized operation of the proposed charging system. **Students will:** Work closely with the graduate researchers at Dr. Mallik's lab, primarily to contribute towards the power stage design optimization and closed loop control implementation of the power converter system. The students will work on the converter simulation, alongside learning PCB design and control logic programming tasks that are integral part of the project execution. The students will also be involved in artificial intelligence (AI)-enabled parameter-invariant control & optimization tasks for ensuring long-term optimized operation of the proposed charging system. **Prerequisite skills/knowledge:** Courses taken on Power Electronics, Control Systems (or equivalent).

Xin Xu	TPS	Clean energy; solid-state batteries	Polytechnic	U. S. Citizen or non-U. S. Citizen

Project description: Our goal revolves around enhancing battery materials specifically tailored for solid-state batteries (SSB), which stand at the forefront of next-generation battery technologies. Our emphasis lies in solid electrolytes, a key element within SSB. Leveraging physical vapor deposition methods like magnetron sputtering and thermal evaporation, we aim to deposit thin films of these solid electrolytes. Through optimization of deposition parameters, we endeavor to tune the chemical composition, film thickness, and point defects, thereby enhancing the material's electrical properties including ionic conductivity, electronic conductivity, etc. **Students will:** Gain practical experience in thin-film deposition techniques, involving tasks such as loading targets/samples, performing deposition processes, and refining optimization protocols. Additionally, they will conduct fundamental electrical conductivity measurements on the deposited thin films. Throughout these activities, all students will receive direct mentorship under my guidance. **Prerequisite skills/knowledge:** Knowledge of materials science and electrochemistry is a plus but not required.

Junfeng Zhao	TPS	Autonomous Vehicle; Electric Vehicle	Polytechnic	U. S. Citizen or non-U. S. Citizen

Project description: We specialize in the design, optimization, and control of advanced systems, including connected and automated vehicles, battery electric vehicles, and smart mobility. Our multidisciplinary research program aims to contribute to the development of safe, clean, and energy-efficient intelligent vehicles and transportation systems, which will shape the future of mobility and provide long-term benefits to society. **Students will:** Be involved in research topics on a prototype autonomous vehicle system, focusing on hardware integration, sensor fusion, mapping, path planning, communication, user interface, safety protocols, testing, and regulatory compliance. **Prerequisite skills/knowledge:** Robotics, Computer Vision, Linux/Ubuntu, C++, ROS.