2025 SURP Project List

College of Art and Science			
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College of Art and Science

Dr. Asela Abeya
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Mathematics and Physics
Lecturer

Project Title: (1) Exploring the Impact of RAG Techniques on AI Math Education

This project will evaluate the mathematical reasoning capabilities of large language models (LLMs) by studying different Retrieval-Augmented Generation (RAG) models, including Standard RAG, Knowledge-Augmented Generation (KAG), and Agentic RAG. The findings will provide insights into optimizing AI for post-secondary mathematics education and lay the groundwork for more reliable and effective AI-assisted learning in higher education.

Student Skills / Requirements: Prerequisite courses: MAT 230 or MAT 260/ Basic knowledge of LLMs, NLP, and AI concepts, or a willingness to learn/ Experience in Python, AI/ML libraries like PyTorch, LangChain/ LaTeX & Mathematical Documentation

Dr. Andrea Dziubek
dziubea@sunypoly.edu
Mathematics and Physics
Associate Professor

Project Title: (2) Modeling and Numerical Simulation using Geometric Mechanics and NGSolve

We model problems from rigid-body mechanics, electromagnetism, and electromechanical systems, and solve them numerically using NGSolve. NGSolve is a high-performance finite element software which integrates mathematical modeling, mesh generation, numerical simulation, and visualization. It supports a wide range of finite element spaces, including those often used in mixed methods (e.g., Raviart-Thomas and Brezzi-Douglas-Marini). Advances in continuum mechanics, structure-preserving numerical methods, and data analysis rely on the same techniques from differential geometry and algebraic topology, which we may explore depending on student interest.

Student Skills / Requirements: Linear Algebra and Calculus III; some Mechanics, Physics, Electromagnetism; Python; LaTeX an advantage.

Dr. Andrea Dziubek
dziubea@sunypoly.edu
Mathematics and Physics
Associate Professor

Project Title: (2b) Geometric Mechanics Modeling and Structure Preserving Numerical Simulation

Differential Geometry and Topology are fundamental to recent developments in Continuum Mechanics (GM) and Structure Preserving Discretizations (SPD).

We reformulate problems from Continuum Mechanics (fluids, elasticity) and electromagnetism in the language of Geometric Mechanics (tensor calculus, exterior differential forms, complexes). Then we solve these partial differential equations numerically using appropriate finite element spaces and mixed methods. For that we use NGSolve, a modern finite element software and a comprehensive platform for modeling, meshing, simulation, and visualization.

Student Skills / Requirements: Linear Algebra and Calculus III; some Mechanics, Physics, Electromagnetism; Python; LaTeX an advantage.

Dr. Pallavi Gupta-Bouder
guptabp@sunypoly.edu
Biology
Lecturer

Project Title: (3) GreenSphere: A Greenhouse and garden initiative at SUNY-Poly

We are seeking students with engineering (preferably Civil/mechanical) to help set up the Greenhouse. We further seek student involvement to configure the initial set up to: assist with building the greenhouse using the kit, internal space management for plant growth to maximize natural resources; conceptualize, test, and install the beta model for efficient watering system; conceptualize, test, and install the initial design for the garden adjacent to the greenhouse.

Student Skills / Requirements: Civil or mechanical engineering

Dr. Pallavi Gupta-Bouder
guptabp@sunypoly.edu
Biology
Lecturer

Project Title: (4) Evaluation of Ecological impact of Cardboard

Comparative evaluation of the economical role of cardboard: Students will research the databases and literature to find out annual consumption, determine the ecological cost of current cardboard consumption and test the sustainability of the current model. They will also investigate and evaluate the data regarding the fate that befalls the cardboard packaging material after it's used and discarded.

Student Skills / Requirements: None

Dr. Pallavi Gupta-Bouder
guptabp@sunypoly.edu
Biology
Lecturer

Project Title: (5) Ecological impact of Cardboard: Repurpose and upcycle cardboard material from used packaging boxes for plant nursery

Repurpose and upcycle cardboard material from used packaging boxes for plant nursery: Conceptualize, create, and test designs for starter planters made from cardboard material and evaluate quality of their beta models. These planter designs will be tested in the newly-established Greenhouse (Project GreenSphere: A Greenhouse and Garden initiative) with a variety of flowering and fruiting seedlings.

Student Skills / Requirements: None

Dr. Kristina Boylan
boylank@sunypoly.edu
History
Professor

Project Title: (6) Creating Collaboratively Across Visual Abilities (CCAVA): Exploring the Boundaries of Free Software and Lower-Cost 3D Printing for Twin-Vision Book and Document Composition

Twin vision books have translucent pages or adhesive overlays on printed pages, to provide blind and visually-impaired readers both the book text and alt-text descriptions of images in Braille. These books afford shared reading experience among sighted and blind or visually-impaired readers, with the text and images/descriptions available simultaneously and sequentially as they read. However, these books are not widely available, with most produced only on request by publishers or subcontracted manufacturers, or by volunteer organizations that use expensive embosser printers to produce adhesive sheets or translucent pages. Even fewer options exist for people to make their own twin-vision books, which could enhance family and classroom storytelling and narration experiences, recording and sharing self-composed personal narratives (think: family histories, travel diaries, yearbooks), academic work (e.g. nonfiction reports) and creative works (e.g. illustrated stories, comics).

The CCAVA project, ongoing at SUNY Poly since 2023, has been working on combining different composition technologies (shared documents accessible via screen, screenreader or refreshable Braille tablet, Braille translators), with experimentation to find ways to affordably and accessibly produce translucent Brailled pages, in order to produce instructions and templates for manuscript production to be shared on the project website. Previous team members' work has resulted in the ability to produce translucent pages, but the process of adding Braille characters to that page remains visual-only, cumbersome, and reliant on licensed software. The SURP 2025 student will research available resources and use their capacities with 3D asset production to find ways to produce Braille letters reliably and repeatedly in free-of-cost 3D design software (think of it like designing a font), and integration of that system with the other elements of the CCAVA twin-vision book program. Deliverables will include the letters themselves and instructions for adding them to existing 3D printing processes (authorial credit will be given on the CCAVA website and other publications).

Student Skills / Requirements: Blender, Tinkercad, other free-of-cost 3D modeling and printing software (open to your suggestions)

Dr. Catherine Cottrell
cottrec@sunypoly.edu
Social and Behavioral Science
Assistant Professor

Project Title: (7) Stigma-By-Association: When Negative Interpersonal Perceptions Spread

A social stigma occurs when an individual is evaluated in a negative light due to possession of a socially devalued characteristic (e.g., mental illness, obesity, criminal history, low SES). Stigma-by-association extends this social phenomenon to those in relationships with the stigmatized person, and occurs when the social associates (e.g., friend, family, romantic partner) of a stigmatized individual are also viewed in a negative light. The purpose of this project is to better understand the psychological processes related to stigma-by-association. The goal is to develop an up-to-date literature review of research and theory on stigma-by-association. If desired, the student may also design a novel empirical study to examine this psychological process in a particular context.

Student Skills / Requirements: PSY 100 and at least 1 additional college psychology course; willingness to learn how to search research databases

Dr. Shing Chi Leung
leungs@sunypoly.edu
Mathematics and Physics
Assistant Professor

Project Title: (8) Impact of aspherical supernova explosions on the enrichment of Si-group elements

The chemical abundances of the Perseus Cluster and some metal poor stars/galaxies have been measured and they show mismatch with canonical supernova models. New supernova models are proposed to reduce the mismatch. In this project, the participating student will use the Galactic chemical evolution code and update the database with the provided supernova yields. The student will study how the new yield affect the chemical enrichment process of the galaxy through these new supernova models, and explain some observed stars/galaxies. The participating student is expected to have completed Calculus-based physics I and II and have basic knowledge in Fortran-like languages and Python-like languages. A functioning laptop with Python and Fortran developing environment (e.g. VS Code, Anaconda) and storage space are required for this project.

Student Skills / Requirements: Fortran-like language, Python-like language, PHY 201/202

Dr. Shing Chi Leung
leungs@sunypoly.edu
Mathematics and Physics
Assistant Professor

Project Title: (9) Impact of new Type Ia supernova models on Fe-group element production

The primordial black hole is one potential candidate to trigger the ignition and explosion of a white dwarf in the form of Type Ia supernovae. It is unclear if this channel could lead to observable effects in the evolution trends of chemical elements. In this project, the student will use the new supernova model to update the Galactic Chemical Evolution code. The participating student is expected to have basic understanding in the galactic evolution physics, numerical differential equations, and have basic knowledge in Fortran-like and Python-like languages for scientific computing. A functioning laptop with Python and Fortran developing environment (e.g. VS Code, Anaconda) and storage space are required for this project.

Student Skills / Requirements: Fortran-like language, Python-like language, numerical methods, PHY201/202

Dr. Shing Chi Leung
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Mathematics and Physics
Assistant Professor

Project Title: (10) Metallicity effects on supernova explosion

The explosions of stars, especially Type Ia supernovae, vary over the cosmic history due to the metallicity effect. It could change our interpretation in the cosmic expansion and thus some fundamental parameters in cosmology. In this project, the participating student will generate the theoretical supernova catalogue with updated metallicity effects. Based on the catalogue, the student will investigate how it affects our interpretation in cosmology. The participating student is expected to have completed Calculus-based Physics I and II, knowledge in random processes, and have basic knowledge in Python-like language for scientific programming. A functioning laptop with Python and Fortran developing environment (e.g. VS Code, Anaconda) and storage space are required for this project.

Student Skills / Requirements: Python-like language, PHY 201/202, Probability/random processes

Dr. Shing Chi Leung
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Mathematics and Physics
Assistant Professor

Project Title: (11) Simulations of Quantum Interference and Algorithm Development

Quantum computing is the proposed direction for next-generation computers which could largely speed up the current computing power. The quantum superposition is one key component to overcome the current computing barrier. In this project, the participating student will develop a graphical interface for the quantum tic-tac-toe which will be deployed in online platform. The project will involve enumerating outcomes and designing strategies. The participating student is expected to have knowledge in discrete mathematics, and programming languages with interactive Graphical User Interface (Python or Javascript and so on, and the associated libraries). A functioning laptop with coding developing environment (e.g. VS Code) and storage space is required for this project.

Student Skills / Requirements: Discrete mathematics, Python/JS language or language with GUI

Dr. Byeongdon Oh
ohb@sunypoly.edu
Social and Behavioral Sciences
Assistant Professor

Project Title: (12) STEM Forward: Designing a More Inclusive Future

Building a diverse and inclusive Science, Technology, Engineering, and Mathematics (STEM) workforce has been essential to sustainable economic growth and national security. However, the persistent underrepresentation of women and racial minorities in STEM education continues to restrict the nation's capacity for technological innovation. This project aims to advance evidence-based policy interventions that promote gender and racial diversity in postsecondary STEM education through a collaborative research effort between SUNY Poly and the University of California, Berkeley. Students will work closely with a faculty advisor to conduct a literature review and develop an online student survey, which will be implemented at SUNY Poly in Fall 2025.

Student Skills / Requirements: A high level of critical reading and writing skills is essential for this project. Proficiency in statistical analysis is preferred.

Dr. Margarita Orlova
orlovam@sunypoly.edu
Biology and Chemistry
Assistant Professor

Project Title: (13) Effect of Environmental Stress on Chemical Communication in Pollinators

The most economically important among pollinators are social bees who establish large and complex societies in which communication is of great importance. In the modern world humans subject them to many stressors such as pesticides and nutritional deficiencies. The project aims to document the impact of these stressors on communication across different pollinator species and will involve observing the behavior of social bees and collecting samples from the wild, from commercial apiaries and from our own campus-reared populations.

Student Skills / Requirements: Absolutely no allergies to insects, pollen or other outdoor materials, no fear of insects, willingness and ability to work outdoors and to perform manual work.

Dr. Steve Schneider
steve@sunypoly.edu
Communications and Humanities
Professor

Project Title: (14) Evaluating User Experiences with Generative AI Systems

This project focuses on developing a structured framework for evaluating user experiences with generative AI systems. Students will explore four key research methodologies—Analysis of Archives, Direct User Measures, Analysis of Outputs, and Model-Only Simulations—to assess how users interact with AI tools like ChatGPT and similar models. The work involves literature reviews, data collection, usability testing, and experimental simulations to refine AIUX research methods. Students with an interest in gathering and analyzing data, of any type, are encouraged to apply. The project will contribute to a broader effort in AI ethics and usability research, helping to inform best practices for AI deployment in real-world applications.

Student Skills / Requirements: Familiarity with Excel/Sheets.

College of Engineering

Dr. Ahmed Abdelaal
abdelaa@sunypoly.edu
Engineering
Assistant Professor

Project Title: (15) Future Climate Impacts on Infrastructure Design Standards

Currently, design codes and standards rely on historical weather data, which do not consider the changes in loading in future conditions. As a result, infrastructure constructed today may not be resilient enough to endure the current or future weather extremes associated with a warming climate. One specific weather hazard likely to be affected is atmospheric icing. Therefore, it is crucial to study how ice loads will be influenced under future conditions.

To conduct this research, future climate data provided by the National Center for Atmospheric Research (NCAR), will be utilized. This work aims to assist the American Society of Civil Engineers (ASCE) in its ongoing effort to update Standard 7: “Minimum Design Loads and Associated Criteria for Buildings and Other Structures.” The upcoming revision, scheduled for 2028, will introduce a new chapter that addresses future conditions related to environmental hazards.

The student will work with Dr. Abdelaal on various research activities. The tasks involved in this project require proficiency in using Excel and the ability to code in Python. The student should be self-motivated and possess a high level of responsibility to complete tasks in a timely manner.

Student Skills / Requirements: Excel, Python, self-motivated

Dr. Asif Ahmed
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Engineering
Assistant Professor

Project Title: (16) Using Artificial Intelligence (AI) to Enhance Construction Learning

Civil (Geotechnical) engineering courses traditionally focus on design principles, often overlooking the critical construction aspects of foundations and earth structures. This project aims to integrate construction-focused modules into 'Foundation Analysis and Design' and 'Design of Earth Structures' courses, enhancing students' understanding of real-world challenges. By leveraging AI technologies, students will gain valuable experience in site investigation, construction sequencing, and failure analysis. AI-powered tools such as Google Earth Pro will allow students to analyze historical construction failures, terrain changes, and soil movement patterns over time. Additionally, AI-enhanced research tools like ChatGPT will assist students in generating construction risk assessments and failure case studies. Through virtual site simulations and AI-driven data analysis, students will explore excavation safety, deep foundation construction, and retaining wall performance.

Student Skills / Requirements: Responsible, good communication skills. Familiar with generative AI. Google Earth Pro and /or Google SketchUp is a plus; eager to learn new software.

Dr. Zahid Akhtar
akhtarz@sunypoly.edu
Engineering
Assistant Professor

Project Title: (17) Shattering the Facade: Pushing Boundaries in Deepfake Detection

This project will tackle the growing challenge of deepfake detection, addressing the increasing threat of altered media. By exploring advanced AI methods, it aims to assess and compare techniques for identifying deepfake videos, focusing on accuracy, robustness, and efficiency. The goal is to provide insights for developing more effective tools to combat the spread of deceptive synthetic media.

Student Skills / Requirements: Python or any programming language but not necessary

Dr. Zahid Akhtar
akhtarz@sunypoly.edu
Engineering
Assistant Professor

Project Title: (18) Securing the Future: AI Approaches to Cyber Threats

This project will focus on designing and developing robust artificial intelligence-based systems to address critical challenges in cybersecurity. The goal is to explore and implement innovative solutions for detecting and mitigating threats. By leveraging machine learning techniques, the project aims to enhance the effectiveness of security systems in real-world scenarios, providing students with hands-on experience in applying advanced algorithms to solve complex cybersecurity problems.

Student Skills / Requirements: Python or any programming language, Basic Cybersecurity knowledge

Dr. Mahmoud Badr
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Cybersecurity
Assistant Professor

Project Title: (19) Securing Smart Grids: Trustworthy AI Against Cyber-Enabled Electricity Theft

In smart grids, homes are equipped with smart meters (SMs) to monitor electricity consumption and handle billing. However, malicious consumers exploit vulnerabilities in these SMs to manipulate consumption readings, reducing their bills illegally through electricity theft. This issue not only compromises grid stability but also results in billions of dollars in losses for electric utility companies (EUCs). To combat this, EUCs are increasingly turning to AI-driven solutions. While AI presents a promising solution, ensuring its trustworthiness is crucial. Therefore, this project aims to develop a robust AI-based system for detecting electricity theft, resilient to adversarial attacks.

Student Skills / Requirements: Python required; Machine Learning is a plus

Dr. Daniel Jones
jonesd5@sunypoly.edu
Engineering
Associate Professor

Project Title: (20) Analysis of Electroencephalography (EEG) Data

We have collected data from participants in the EEG laboratory. Signals are measured with 256 sensors at 1,000 Hz while participants provide emotional response to photographs. This project aims to analyze the data to understand neural activity of the brain in response to the images.

Student Skills / Requirements: General computer skills for analyzing data, preferably Matlab and Excel (or a desire to learn), motivation to work independently

Dr. Abolfazl Karimpour
karimpa@sunypoly.edu
Engineering
Assistant Professor

Project Title: (21) Smart Infrastructure for Sustainable Roads: Insights into Driver Behavior with AI-Enhanced IoT Solutions

This project introduces a concept called Personalized Connected Vehicle Messaging System (PCVMS), a novel approach designed to enhance driver attention and safety by delivering real-time, customized alerts tailored to individual driver needs. PCVMS advances traditional alert methods by providing personalized audio notifications that address critical issues such as speeding and distraction, both within vehicles and on variable message signs. In phase one, we leverage Virtual Reality (VR) environments to simulate high-risk scenarios—such as work zones, traffic signals, and roadway incidents—on arterials and freeways. These simulations capture a comprehensive set of driving behaviors, including speed patterns, reaction times, and subtle indicators of inattention, fatigue, or distraction. This data will inform a robust classification system that identifies risky driving behaviors and triggers tailored feedback messages for drivers. The system's effectiveness will be thoroughly tested in VR simulations, enabling scenario replication and detailed analysis of driver responses. Based on the results captured in Phase I, we will evaluate the potential for real-world implementation using Internet of Things (IoT) technologies, including Roadside Units (RSUs) and Onboard Units (OBUs).

Student Skills / Requirements: Unity, SUMO, and Python

Dr. Abolfazl Karimpour
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Engineering
Assistant Professor

Project Title: (22) Developing Smart Roadway Safety Chatbot: Enhancing Community Road Safety Through AI-Powered Assistance

We are developing an interactive safety chatbot designed to provide users with real-time, data-driven insights on roadway safety. This AI-powered tool will utilize police crash report data, OpenStreetMap (OSM) data, and other relevant sources to answer safety-related questions from the community. Whether users seek information about high-risk areas, traffic incident trends, or general road safety guidance, the chatbot will offer reliable and context-aware responses. By integrating multiple data sources and leveraging advanced AI capabilities, this chatbot aims to enhance public awareness, support safer decision-making, and foster a proactive approach to roadway safety.

Student Skills / Requirements: Python and Data Analytics

Dr. Amir Manzourolajdad
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Computer Science
Assistant Professor

Project Title: (23) RNA Molecule Design

RNA inverse design is an essential part of many RNA therapeutics strategies. We have a machine-learning model that learns the geometry of the RNA molecule and its chemical bonds and generates sequences that will have desired structure. The job requires just running this program and organizing output. Program is in Python. you many need a good linux machine. details: https://www.preprints.org/manuscript/202412.2156/v1

Student Skills / Requirements: Python, CS 240

Dr. Amit Sangwan
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Electrical and Computer Engineering
Assistant Professor

Project Title: (24) Nanoscale Sensing and Comms. Design and Modelling

In the rapidly evolving field of nanotechnology, the development of nano-scale sensing and actuation devices is paramount. These devices promise to revolutionize numerous applications, from medical diagnostics to environmental monitoring. This project aims to model and develop computational frameworks for nano-scale sensing and actuation devices, focusing on the integration of electromagnetic (EM) nano-antennas and molecular communications (MC).

Student Skills / Requirements: MATLAB, Python, basics in electromagnetism and/or signal processing

Dr. Aarthi Sekaran
sekaraa@sunypoly.edu
Engineering
Assistant Professor

Project Title: (25) Flow Physics of an Intubated Human Trachea

An increase in respiratory illnesses (including COVID-19) in the recent past has led to a resurgence of interest in respiratory flow physics, including the dynamics of airflow through tracheal passages. An accurate understanding of this flow is challenging, owing to the intricate pathways further complicated by the presence of mucus secretions lining the airways. The present study proposes a detailed analysis of the upper trachea focusing on the non-Newtonian flow interactions between the mucus and airflow, towards developing a predictive model for mucus transport and accumulation. This will be carried out via high-fidelity Computational Fluid Dynamics (CFD) models and validated by matched experiments using Particle Image Velocimetry (PIV) and high-speed photography. The study will reveal the influence of (1) endotracheal cuff shape (2) mucus composition and (3) airflow rate on the flow instabilities responsible for mucus movement. These results will then be employed in an analytic model relating the aforementioned parameters and develop a framework for enhanced design of mechanical ventilation assemblies (including ventilator flow cycles and endotracheal tube design).

Student Skills / Requirements: Student must be an ME/MET rising senior (must have had courses in Fluid Dynamics). Student must also be willing to work on both experimental setup (in the lab) and computational work.Basic knowledge of programming, MATLAB/python recommended.

Dr. Priyangshu Sen
senp@sunypoly.edu
Electrical and Computer Engineering
Assistant Professor

Project Title: (26) Measurement of the Near and Far-Field Channel Profiles for Rough Surfaces, Such As Outdoor Vegetation, To Understand the Channel Propagation Characteristics.

The terahertz (THz) band wireless system is an essential technology that maximizes the potential of joint communication and sensing systems. In agricultural field scenarios, this technology can facilitate communication between machine-to-machine devices, and the same waveform can be utilized to monitor vegetation growth. Accurate channel information is vital at THz frequencies, as channel characteristics can change dramatically with even slight environmental variations.

In this project, undergraduate students will work under the supervision of a professor to measure and characterize the properties of the THz band channel. They will estimate metrics by considering the reflection properties of signals interacting with rough surfaces similar to those found in vegetated environments.

- Week 1 - 2: The undergraduate student will receive comprehensive training in channel-sounding techniques, as well as learn about critical wireless channel metrics, including path loss, k-factor, delay spread, and angular spread.

- Week 3 - 4: The student will familiarize themselves with the MATLAB-based channel sounder used on the THz testbed. Additionally, they will set up the measurement environment.

- Week 5 - 7: The team will collect data under various scenarios, focusing on reflections off rough surfaces in both near-field and far-field conditions.

- Week 8 - 10: The student will analyze the captured data to estimate channel metrics.

The results will be documented for presentation and submission to high-impact conferences or workshops.

Student Skills / Requirements: Second, third or higher year ECE student with prior experience in MATLAB, familiarity with the software-defined radio technology.

Dr. Priyangshu Sen
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Electrical and Computer Engineering
Assistant Professor

Project Title: (27) Optimizing the Next-Generation Single-Carrier Waveform Design for Terahertz and mmWave Application: Amplitude Phase Shift Keying.

Upper mmWave and Terahertz (THz) band communication is considered a crucial technology for next-generation communication systems (6G and beyond), as it addresses the issue of limited bandwidth and enhances data rates. However, utilizing high-frequency bands presents challenges such as significant path loss, small wavelengths, and the limitations of existing device technologies. To establish reliable communication and facilitate the development of next-generation systems, innovative solutions for both the physical and medium access control layers are essential. Current research places great emphasis on developing a new waveform capable of functioning effectively at THz and mmWave frequencies, thereby ensuring a reliable communication link.

In this project, the undergraduate student will focus on designing and optimizing next-generation single-carrier waveforms using Amplitude Phase Shift Keying (APSK) under the supervision of the professor.

- Weeks 1 - 2: The student will undergo intensive training in contemporary single-carrier waveform technologies and explore innovative solutions for THz frequencies. MATLAB will be utilized as a simulation tool to evaluate the performance of the schemes.

- Weeks 3 - 4: The student will develop the software-defined backbone for the APSK communication system for the THz testbed located at the Advanced Communication Electronics and Sensing (ACES) Laboratory within the ECE department.

- Weeks 5 - 6: The student will work on improving the performance of the APSK single-carrier waveform schemes through simulation.

- Weeks 7 - 8: The student will assess the performance of the scheme in a real-world environment within the testbed.

- Weeks 9 - 10: Finally, the student will analyze the results and document the findings for presentation and for potential publication in a high-impact conference or workshop.

Student Skills / Requirements: Second, third or higher year ECE student with prior experience in MATLAB, familiarity with the software-defined radio technology.

Dr. Jiayue Shen
shenj@sunypoly.edu
Engineering
Assistant Professor

Project Title: (28) Mechanical Design and Locomotion Development of a Bio-Inspired Soft Robot

This project focuses on the mechanical design and locomotion of a bio-inspired soft robot, modeled after the movement strategies of earthworms and snakes. The robot will utilize flexible, segmented structures and soft actuators to achieve peristaltic crawling or undulatory motion, enabling it to navigate through confined or complex terrains. Key mechanical aspects include designing adaptable friction control mechanisms, optimizing body deformation, and integrating efficient actuation methods such as pneumatic or tendon-driven systems. At this stage, the robot will be manually operated to test and refine its locomotion capabilities.

Student Skills / Requirements: Position 1: 3D printing, mechanical Design and Fabrication, fluid mechanics; Position 2: electronic control

Dr. Jiayue Shen
shenj@sunypoly.edu
Engineering
Assistant Professor

Project Title: (28b) Exploration of Surface-Structured Titanium Alloys for Breath Microdroplet Capture and Preliminary Health Monitoring

This project investigates the use of smooth and micro/nanostructured titanium alloy surfaces to enhance the capture of breath microdroplets for resistive sensing. Students will fabricate simple breath sensors using biocompatible conductive coatings and evaluate sensor performance using Arduino-based resistance measurements. Controlled breath exposure experiments will quantify droplet accumulation, contact angle changes, and electrical response. The goal is to determine how surface engineering affects sensitivity and potential for future health monitoring applications.

Preferred skills:

- Basic understanding of materials science or surface engineering (helpful but can be taught during the project)
- Basic experience in electronics (Arduino programming, breadboarding circuits)
- Ability to follow experimental protocols carefully and consistently
- Data analysis skills (Excel, Python, or similar; basic graphing and statistics)
- Scientific writing skills (reporting experimental results in formal style)

Note: Students **do not need** prior experience with titanium processing or sensor fabrication — training and procedures will be provided.

Expected deliverables:

- Fabricated sensor prototypes on both smooth and structured titanium alloy substrates
- Quantitative data sets, including:
- Microdroplet capture measurements
- Contact angle measurements (or visual assessments)
- Resistance vs time curves during breath exposure
- Comparative analysis between smooth and structured surfaces

Dr. Arjun Singh
singha8@sunypoly.edu
Electrical and Computer Engineering
Assistant Professor

Project Title: (29) THz Bessel Beams for Wavefront Engineering

In this project, students will help in the design of THz Bessel beams through an Axicon. Bessel beams help in the facilitation of near-field communications, which is a pivotal area of research for THz communications. The student will be provided with access to COMSOL Multiphysics software to run simulations that help arrive at an accurate Axicon design, followed by 3D printing of the Axicon. The student will help to integrate the Axicon with teh ACES THz Testbed at SUNY Poly and perform measurements and post processing of the data to help arrive at final results of near-field THz communications.

Student Skills / Requirements: Signals and systems, MATLAB

Dr. Arjun Singh
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Electrical and Computer Engineering
Assistant Professor

Project Title: (30) MIMO in THz - Characterization

Multiple Input Multiple Output (MIMO) is a promising research direction in the area of THz communications. With multiple antennas available in the ACES THz testbed, the team at SUNY Poly is uniquely positioned to derive experimental results and help in turning theory into practice as MIMO implementation in THz is realized. This requires a full and comprehensive channel measurement survey, with exhaustive measurements taken with multiple antennas, configurations, and communication scenarios.

Student Skills / Requirements: Signals and systems, MATLAB

Dr. M Jasim Uddin
uddinm3@sunypoly.edu
Civil and Mechanical Engineering
Professor

Project Title: (31) Energy Generation

TENG (Triboelectric Nanogenerator) is a technology that converts mechanical energy into electricity using the triboelectric effect and electrostatic induction. It is widely used for harvesting energy from everyday movements, such as walking or vibrations, to power small electronic devices. TENG has gained attention for its potential in sustainable energy solutions due to its lightweight, cost-effectiveness, and ability to generate power from ambient mechanical sources.

Student Skills / Requirements: Junior or Senior Standing

Dr. Zhanjie Li
liz1@sunypoly.edu
Civil Engineering
Professor

Project Title: (32) Computational simulations of mechanical performance of steel connections in structures

The project focuses on computational simulation of apex connections used structures. We will use SolidWorks to build the apex connection, which is a parametrized model allowing exploring a variety of dimensions (already have this model ready). This model will then be converted into finite element models in ABAQUS to simulate its structural behaviors under static loading. I will guide the modeling techniques and potential exploration domain.

Student Skills / Requirements: The mechanics requires basically understanding of statics and strength of materials. No need to understand how it is designed (civil engineering design specification). We will focus on the mechanics using computational simulations.