SURP 2026 Project List

College of Arts and Sciences

College of Engineering

College of Arts and Sciences

Dr. Andrea Dziubek

dziubea@sunypoly.edu
Mathematics
Associate Professor

Project Title: (1) Modeling and Numerical Simulation of Problems in Geometric Physics

We will model problems from rigid-body mechanics, electromagnetism, and/or electromechanical systems, and solve the resulting partial differential equations numerically using appropriate modern finite element spaces and mixed methods. For that we use NGSolve, a high-performance comprehensive platform for modeling, meshing, simulation, and visualization.

Student Skills/Requirements: Python; Linear Algebra and/or Calculus III and/or Calculus based Physics II; some interest in Mechanics or Electromagnetism; LaTeX an advantage.

Project Title: (2) Modeling and Analysis of Problems in Geometric Physics

Recent advances in continuum mechanics, numerical methods and data analysis/AI rely on the same techniques from differential geometry and algebraic topology. We will model problems from rigid-body mechanics and electromagnetism in the language of geometric physics (tensor calculus, exterior differential forms, complexes) and study them.

Student Skills/Requirements: Linear Algebra, Calculus III; some interest in Mechanics or Electromagnetism; Calculus based Physics II and LaTeX an advantage.

Dr. Pallavi Gupta-Bouder

guptabp@sunypoly.edu
Biology and Chemistry
Lecturer

Project Title: (3) Effects of PFOA and PFAS on early plant growth in lettuce and basil plants

Currently, my work focuses on studying the effects of forever chemicals such as PFOA and PFAS on plants. These chemicals contaminate our soil and water and thereby get absorbed by the plants. In addition to picking up these chemicals from their environment, humans also can ingest them by consuming plants exposed to them. These chemicals are known for their adverse effects in humans including cancer, congenital defects, and damaging effects on the immune system, kidneys, and liver, etc. My research is interested in studying the effects of PFOA and PFAS on seed germination and early plant development using edible leafy plant models such as lettuce, basil, etc. My research further focuses on studying the oxidative stress caused by these chemicals during early plant development and growth. I would like to investigate how exposure to these chemicals affects the expression of genes that regulate the oxidative environment of the cell. Further, I would like to study how these gene expression is manipulated by the plant cells to regulate and mitigate the oxidative stress caused by these chemicals.

Student Skills/Requirements: N/A

Dr. Shing Chi Leung

leungs@sunypoly.edu
Physics
Assistant Professor

Project Title: (4) Quantum Gate Simulations

Quantum computing is the future direction to leverage the quantum superposition that breaks the current classical computing of using bits ("1" and "0"). It leads to the questions of how to manifest such an advantage by manipulating quantum states (electron spin in general) and their entanglement to perform calculation, in a way much faster than classical computers.

In this project, the participating student will use Python to develop simulation codes for quantum logic gates, and study how the standard logic gates can be realized by the interaction of electrons through the entanglement process. The student will experiment building some quantum neurons, and compare with the classical neurons.

Student Skills/Requirements: Python (proficient), programming structure, linear algebra

Project Title: (5) Neutron Star Structure with accreted Primordial Black Hole

Dark matter, a prominent component in the mass budget of the universe, is believed to be in the form of a primordial black hole. Such black holes may be accreted inside a neutron star and consume the matter from the inside. This kind of object could be the site for r-process elements.

In this project, the student will use Fortran or Python to calculate the realistic neutron star structure, under the influence of black hole accretion and its additional gravity on the neutron star. The student will develop a database documenting these configurations for future calculations.

Student Skills/Requirements: PHY202 or above, Python (Intermediate), ODE, programming structure

Project Title: (6) Metallicity dependence of Type Ia supernovae

Type Ia supernova (SN Ia) is the explosion of a carbon-oxygen white dwarf evolved from 3 - 8 solar mass stars. The SN Ia explosion in the early universe has been of interest recently due to the discovery of metal-rich early galaxies.

In this project, the participating student will use the Fortran code to calculate the chemical yields (i.e. nucleosynthesis) of Type Ia supernovae at different metallicity. The student will analyze the chemical composition, and hence its metal-enrichment process in the galactic scale. Then the student will use Python to do the visualization.

Student Skills/Requirements: Fortran or C-type programming experience (upper-intermediate), PHY202 or above, Python (Intermediate)

Dr. Margarita Orlova

orlovam@sunypoly.edu
Biology and Chemistry
Assistant Professor

Project Title: (7) Small brains, big questions: how do insects learn and interpret complex signals?

How does a simple brain perceive a complex world? The answer to this question can help us not only understand the living creatures around us but also help us build more intelligent machines ready to solve real-life problems. This project aims to understand how bumble bees – little creatures with small brains but large nests and impressive cognitive abilities – learn and process complex signals. We will present them with puzzles to solve and observe how they cope with these tasks. The work will include setting up experiments with live bumble bees, behavioral observations, dissections and antennal preparations.

Student Skills/Requirements: No fear of insects, ABSOLUTELY NO allergies, willingness to work outdoors and perform physical tasks, a passing grade or higher in BIO104 (preferred).

Project Title: (8) Save the bees: developing methods for non-lethal pesticide detection on body surfaces of pollinators

Wild pollinators such as bumble bees are an integral part of natural and agricultural ecosystems. Many locally grown crops rely on these often unnoticed but essential helpers. Yet in the modern world they are faced with multiple stressors created by humans, such as exposure to pesticides, pathogens and lack of food resources. This project aims to develop new non-lethal and field-applicable methods for the detection of pesticides and pesticide-induced changes in lipid chemistry on the body surface of bumble bees. The project offers the students an opportunity to try their hand at a variety of techniques, from analytical chemistry and microdissections to live insect rearing and sample collection in the wild.

Student Skills/Requirements: No fear of insects, ABSOLUTELY NO ALLERGIES, willingness to work outdoors and perform physical tasks, passing BIO104 preferred.

College of Engineering

Dr. Ahmed Abdelaal

abdelaal@sunypoly.edu
Engineering Technology
Assistant Professor

Project Title: (9) Development and Evaluation of a Smart Solar-Powered Roof Heating System

This project aims to design and build a scaled residential roof model equipped with a smart heating system for ice and snow mitigation, to be evaluated under real winter conditions. The system integrates temperature and ice-detection sensors with an Arduino-based control unit to activate graphite heating pads only when needed. Power is supplied through a solar-charged battery system with backup support to ensure reliable cold-weather operation. Students will be involved in system integration, experimental testing, data collection, and performance evaluation during winter conditions. The project offers hands-on experience in embedded systems, renewable energy, thermal testing, and smart infrastructure design.

Student Skills/Requirements: Basic programming experience (Arduino, Python), Introductory circuits and electronics (sensors, relays, power supplies), Ability to work with experimental setups and data collection, Familiarity with CAD or 3D printing is a plus but not required

Dr. Asif Ahmed

ahmeda3@sunypoly.edu
College of Engineering
Associate Professor

Project Title: (10) Geotechnical Data Visualization through Designing 3D subsurface models

The DIGGS ((Data Interchange for Geotechnical and Geoenvironmental Specialists) project consists of a GML/XML-based standard schema for the transfer of geotechnical and geoenvironmental data within an organization or between multiple organizations, plus supporting resources, such as code list dictionaries and validation tools. DIGGS can work with existing software, hardware, databases and data storage facilities to easily transfer and share your data. Using the sample data in the DIGGS platform, the project aims to develop data visualization through three dimensional (3D) modeling. Visit the GitHub repository for complete details, resources, sample data: https://github.com/DIGGSml

Student Skills/Requirements: Python

Dr. Zahid Akhtar

akhtarz@sunypoly.edu
Electrical and Computer Engineering
Assistant Professor

Project Title: (11) Detecting Deepfakes: An Empirical Study of AI-Generated Media and Detection Techniques

Deepfakes are fake videos, images, or audio generated using AI that can make people appear to say or do things they never did. This project will study how they can be detected, and how effective and robust the detection models are. Various machine-learning models will be trained and evaluated to distinguish real media from deepfake content.

Student Skills/Requirements: Python, or Any programming language

Project Title: (12) Study of Large Language Model Hallucinations

This project will empirically evaluate how often large language models (LLMs) provide incorrect, incomplete, or unsafe AI-based advice in Computer Based Fields. The project will develop samples using authoritative ground truth from standard institutes in the field. The project will use different prompt, and the responses will be systematically analyzed.

Student Skills/Requirements: N/A

Project Title: (13) Generative AI for Cybersecurity

This project will explore how generative AI models can assist in cybersecurity tasks. It will evaluate the accuracy, completeness, and reliability of AI-generated solutions compared to established cybersecurity standards.

Student Skills/Requirements: N/A

Dr. Mahmoud Badr

badrm@sunypoly.edu
Cybersecurity
Assistant Professor

Project Title: (14) Hardening AI-Based Electricity Theft Detection Models Against Adversarial Attacks

AI is increasingly used to secure critical infrastructure, including smart power grids. One important application is AI-based electricity theft detection, where machine learning models identify malicious consumers who manipulate smart meter readings to illegally reduce their electricity bills. While these AI detectors have demonstrated strong performance, they are vulnerable to adversarial attacks that can intentionally mislead the models and evade detection. In this project, we will investigate how adversarial techniques can be designed to attack AI-based electricity theft detectors and develop strategies to strengthen and harden these models against such attacks. The work will contribute to more secure and trustworthy AI systems in smart energy infrastructures and beyond.

Student Skills/Requirements: Python, Machine Learning

Dr. Kazi Imran

imrank@sunypoly.edu
Engineering Technology
Assistant Professor

Project Title: (15) Analysis of Fiber Reinforced Composites Structure using Finite Element Method (FEM)

Fiber reinforced composites offer high strength-to-weight ratios, corrosion resistance, and design flexibility, making them attractive for many engineering applications. However, their anisotropic and heterogeneous behavior poses challenges for structural analysis. This project focuses on the numerical analysis of fiber reinforced composite structures using the Finite Element Method (FEM) to accurately predict their mechanical behavior under various loading conditions. Commercial FEM software (such as ANSYS or ABAQUS) will be used to perform simulations and validate results against theoretical predictions or available experimental data.

Student Skills/Requirements: N/A

Dr. Abolfazl Karimpour

karimpa@sunypoly.edu
Civil and Mechanical Engineering
Assistant Professor

Project Title: (16) Seeing the Crash Before It Happens: AI-Powered Detection of Near Misses at Signalized Intersections

This project proposes the development of an AI-based video analytics model to automatically detect and characterize near-miss events at signalized intersections using existing State DOT video data. By processing continuous video streams, the model will identify vehicle-to-vehicle and vehicle-to-pedestrian near misses that signal elevated crash risk but often go unrecorded in traditional safety datasets. The research will focus on designing and validating robust computer vision and machine learning methods capable of accurately capturing these critical safety exposures across diverse intersection environments. The resulting tool will provide transportation agencies with a proactive, data-driven approach to identifying hazardous conditions, enabling earlier and more targeted safety interventions before serious crashes occur.

Student Skills/Requirements: Coding skills (e.g., Python), some sort of understanding of AI/ML, Computer Skills, Computer Vission

Project Title: (17) Can Algorithms Change How We Drive? A Data-Driven Study of Speed Enforcement and Driver Behavior

This project will evaluate the impact of Automated Speed Enforcement (ASE) on driver speeding behavior and traffic safety by leveraging detailed speeding data, work zone locations, and ASE installation sites. The study will examine how drivers respond to ASE over time, including changes in speed compliance, speed variance, and the persistence of behavioral effects both within and beyond enforcement zones. By comparing conditions before and after ASE deployment—and against comparable non-ASE locations—the research will isolate the influence of automated enforcement from other roadway or traffic factors. Additional analyses will explore spatial spillover effects, such as whether speed reductions extend upstream or downstream of ASE locations, and contextual differences across work zones, roadway types, and traffic conditions. The project will also assess safety outcomes by linking behavioral changes to crash frequency and severity where data permit. Findings will provide State DOTs and SHSOs with actionable evidence on where, when, and how ASE is most effective, supporting data-driven decisions on enforcement strategies and investments aimed at reducing speed-related crashes and advancing roadway safety goals.

Student Skills/Requirements: Python programming, Big Data Analytics, AI/ML Modeling

Dr. Zhanjie Li

liz@sunypoly.edu
Civil and Mechanical Engineering
Professor

Project Title: (18) Wafer Warpage Investigation

The student's work centers on:

- Mechanisms of warpage formation, including uneven stress induced by thin-film deposition, ion implantation, non-uniform thermal cycling, and mechanical handling effects.
- Thermo-mechanical modeling and quantification of warpage, combining analytical formulations and numerical simulations to evaluate how material properties, layer configurations, and processing conditions influence wafer deformation.
- AI- and ML-enhanced modeling approaches, in which machine learning is used to augment physics-based simulations by identifying nonlinear relationships between processing parameters, thermal histories, residual stresses, and resulting warpage.

Student Skills/Requirements: Required skills: Mechanical engineering students with basic mechanics, programming, and modeling

Dr. Amit Sangwan

sangwaa@sunypoly.edu
Electrical and Computer Engineering
Assistant Professor

Project Title: (19) Spatial AI and Nanonetworks

This project introduces undergraduate researchers to emerging frontiers in spatial artificial intelligence and nanoscale communication networks. Students will help design and simulate intelligent nano-sensor systems capable of mapping their environment, coordinating movement, and exchanging information within complex biological or engineered spaces. The work blends machine learning, wireless communication theory, and physics-based simulation to develop new strategies for sensing and navigation at extremely small scales. Through hands-on modeling, coding, and experimentation, participants gain experience with cutting-edge technologies that underpin future biomedical, environmental, and smart-device systems.

Student Skills/Requirements: Matlab, Python

Project Title: (20) Nanoscale communications for bio implant systems

We will model a nanoscale EM communication system that sends data using electromagnetic waves for future implant devices and advance sensing and nanoscale communication systems.

Student Skills/Requirements: MATLAB and Python

Dr. Aarthi Sekaran

sekaraa@sunypoly.edu
College of Engineering
Assistant Professor

Project Title: (21) Computational Modeling of Cleaning Fluid Dynamics in Microbump-Scale Geometries

The continued miniaturization of electronic devices has driven the widespread adoption of microelectromechanical systems (MEMS) and advanced semiconductor packaging technologies. These systems rely on densely packed microbumps to achieve reliable electrical interconnections, often with pitches below 150 μm. As feature sizes shrink, effective post-processing cleaning becomes increasingly critical to device reliability, yield, and long-term performance.
Cleaning fluids must penetrate narrow gaps between microbumps to remove residues and contaminants without damaging sensitive structures. The effectiveness of this process is governed by complex fluid–structure interactions, including capillary forces, solvent penetration depth, flow resistance, and temperature-dependent fluid properties. Understanding these phenomena is essential for optimizing cleaning strategies in advanced microelectronic manufacturing. Computational Fluid Dynamics (CFD) has emerged as a powerful tool for investigating cleaning fluid behavior in confined and intricate geometries. Existing CFD models have provided valuable insights into fluid transport and capillary-driven flow in micro-scale environments. However, many models

simplify key physical interactions or fail to capture their combined effects under realistic operating conditions.
The objective of this project is to extend and refine current CFD modeling approaches to more accurately simulate cleaning fluid behavior within tightly spaced microbump geometries. By incorporating the coupled effects of capillarity, flow resistance, solvent transport, and thermal influences, the proposed model aims to provide a more comprehensive and predictive framework for evaluating and optimizing cleaning processes in advanced microelectronic systems.

Student Skills/Requirements: Matlab, Excel, Technical Writing, Knowledge of Fluid dynamics/ heat transfer, technical writing

Dr. Jiayue Shen

shenj@sunypoly.edu
Engineering Technology
Associate Professor

Project Title: (22) Stride-Ride: Human-Centered Soft Actuation for Assistive Mobility

This project builds on existing Stride-Ride research outcomes and focuses on improving the performance, robustness, and real-world reliability of a wearable soft robotic mobility assistance system. The work emphasizes applied, data-informed engineering design, integrating sensing, embedded systems, and soft robotic actuation to interpret human motion and deliver context-aware assistance. In alignment with the 2025 SURP theme, the project explores how intelligent system architectures—grounded in sensor data and control logic—can support safe, human-centered assistive technologies. The project is inherently interdisciplinary and hands-on, connecting mechanical design, sensing, and control to address real-world challenges in mobility and independence.

Student Skills/Requirements: Some familiarity with coding is preferred, such as being comfortable reading and understanding existing code (e.g., MATLAB, Python, or Arduino), but advanced programming experience is not required. An introductory understanding of fluid power concepts (such as basic pneumatics) is helpful, as the project involves pneumatic actuation. Students should be interested in hands-on learning and willing to work with hardware, sensors, and experimental setups; guidance and training will be provided throughout the project.

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

Project Title: (23) AI integrated manufacturing for system modeling

We propose developing an optimized manufacturing model for a system-monitoring application that enhances real-time data acquisition, streamlines production workflows, and improves decision-making. The model will integrate predictive analytics, automated performance tracking, and resource optimization to increase efficiency, reduce downtime, and support scalable, intelligent manufacturing operations.

Student Skills/Requirements: ME/CS/EE junior/sophomore standing

Dr. Joseph Wasswa
wasswaj@sunypoly.edu
Civil and Mechanical Engineering
Assistant Professor

Project Title: (24) Trends and Composition of CECs in Mohawk River and its Watershed: Integrating Machine Learning, Non-Targeted Screening, and Risk Assessment Across Rural and Urban Hotspots

This project will survey contaminants of emerging concerns across potential hotspots in Mohawk River and its watershed including rural and urban agricultural farms, wastewater treatment plant influent and effluent, drainage channels, manufacturing and processing facilities, airfields and military installations, and areas adjacent to industrial sites.

Student Skills/Requirements: Python, Mass spectrometry, Laboratory analysis

Project Title: (25) Multimodal and Multi-model Fusion for improving molecular property prediction for biodegradability of environmental pollutants

In this study, we will systematically investigate the impact of multimodal learning and multimodel fusion strategies on machine learning (ML) performance for molecular property prediction. Our evaluation will encompass four distinct modeling strategies: (i) models trained solely on RDKit descriptors, representing a single-modality, (ii) early-stage multimodal learning, in which RDKit descriptors are combined with Mol2vec embeddings, (iii) models utilizing pretrained graph neural networks (GNNs), to extract either graph-based embeddings or direct predictions from molecular graph representations, and (iv) heterogeneous multimodel fusion, where RDKit descriptors are fused with GNN-derived outputs via either early fusion (concatenation of descriptors with GNN embeddings) or late fusion (combination of descriptors with GNN prediction outputs).

Student Skills/Requirements: Python