Purdue School of Industrial Engineering
2024 Summer Research Internship Program – Project Descriptions

Project Title: "Enhancing Grid Resilience and Sustainability: A Comprehensive Study of the U.S. Midwest Region"

Brief Description: We are excited to offer a unique internship opportunity focusing on the development of a Midwest regional model for advanced grid analysis. This project aims to leverage the High-Performance Electrical Energy Systems Simulator (HELICS https://helics.org/) and synthetic grid data to develop an integrated wholesale-retail electricity market model to explore critical areas such as long-term system planning, short-term grid operation, distributed energy resources (DER) integration, and the impact of various policies on grid emissions.

Interns will have the chance to work on cutting-edge research that combines state-of-the-art optimization, machine learning, and simulation methods with extensive grid data, providing insights into the future of energy systems. The project's scope includes, but is not limited to:

Developing and validating a comprehensive model of the Midwest's electrical grid using the synthetic grid data (https://electricgrids.engr.tamu.edu/) and a co-simulation framework based on HELICS/ MatPower/GridLab-D.

Using machine learning methods to general random scenarios to reflect climate change risks.

Collaborating with a team of experienced researchers and graduate students to evaluate short-term and long-term planning scenarios for the regional grid.

Ideal Candidate Profile:

We are looking for highly motivated and skilled students with strong backgrounds in applied mathematics, statistics, electrical engineering, computer science, or a related field. Programming skills with Python, Julia, MATLAB, or C++ are required. Experiences with simulation tools, data analysis, and energy systems are not required, but will be highly valued.

Ideal Duration: ~2 months – 05/20/2024 -- 08/01/2024

How to Apply:

Interested candidates should submit a CV, a brief statement of interest, and any relevant project or coursework examples to the contact below.

Project Sponsors:

Prof. Andrew Liu,
School of Industrial Engineering, Purdue University.
Email: AndrewLiu@purdue.edu. Website: https://engineering.purdue.edu/Intel2Grid

Prof. Siva Seetharaman,
School of Industrial Engineering, Purdue University.
Email: sseetha@purdue.edu. Website: https://sivaranjanis.com/

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2024 Summer Research Internship Program – Project Descriptions

Project Title: "Human Factors Engineering: Enhancing Performance of Nurses and Surgeons"

Brief Description: High physical and cognitive workload among surgeons and nurses are becoming more common. The purpose of this project is to examine the contributors to these and develop technology to understand and enhance their performance.

The student will participate in data collection in the operating room at Indiana University School of Medicine, data analysis and interpretation, and write his/her results for a journal publication. The student will regularly communicate his/her progress and results with faculty, graduate mentors, and surgeon collaborators.

Desired experience: Human Factors, Machine Learning, Sensors, Programming

How to Apply:

Interested candidates should submit a CV, a brief statement of interest, and any relevant project or coursework examples to the contact below.

Project Sponsor:

Prof. Denny Yu,
School of Industrial Engineering, Purdue University
School of Health Sciences (by Courtesy), Purdue University
Adjunct Associate Professor of Surgery, Indiana University School of Medicine

Email: dennyyu@purdue.edu. Group Website: https://engineering.purdue.edu/YuGroup

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Project title: "Cascades on networks"

Brief description: Networked-systems are prone to disruptions – a recent example is the catastrophic disruption in the global supply chain caused by the Covid-19 pandemic. In such systems, it is often possible to observe how the disruption propagate through the system locally and the objective is to predict whether there will be a global disruption or not. The project aims to develop foundational methods to study such propagation effects.

Desired experience: The project requires a strong background in probability and network science.

Contact:
Prof. Souvik Dhara
School of Industrial Engineering, Purdue University
Email: sdhara@purdue.edu. Website: https://www.souvikdhara.com

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2024 Summer Research Internship Program – Project Descriptions

Project title: "A complex stochastic systems framework for space operations engineering"

Brief description: This summer project concerns the development and numerical implementation of stochastic models of the spatio-temporal evolution of Low earth orbit (LEO). LEO, defined as altitudes between 100KM and 2000KM above the surface of the planet, has entered an era of unprecedented growth of the number of man-made objects driven by commercial operators such as SpaceX's Starlink constellation and/or Amazon's Kuiper constellation. This surge in LEO objects poses unprecedented challenges for space operators to minimize the chance of collisions, and avoid potentially catastrophic debris generating events.

The student working on this project will be expected to carry out extensive simulation of complex interacting particle systems and compartmentalized stochastic models. This includes novel density-dependent Markov processes and compartmentalized models with particle diffusion through space. The overall goal of the project will be to gain a reasonable understanding of percolation thresholds (ex., a minimum density threshold) above which runaway cascading effects (resulting in uncontrolled collisions) are apparent in LEO, using numerical and simulation-based methodologies.

Desired experience: The project requires a strong background in stochastic modeling.

Contact:

Prof. Harsha Honnappa
School of Industrial Engineering, Purdue University
Email: honnappa@purdue.edu. Website: https://engineering.purdue.edu/SSL

Prof. Souvik Dhara
School of Industrial Engineering, Purdue University
Email: sdhara@purdue.edu. Website: https://www.souvikdhara.com

Purdue School of Industrial Engineering
2024 Summer Research Internship Program – Project Descriptions

Project title: "Orbital Vehicle Routing Problem"

Brief description: The orbital vehicle routing problem (VRP) stands at the forefront of innovation in robotic logistics, especially as it applies to space operations. Our project is focused on developing and refining a model for this complex issue, targeting the efficient deployment of service robots. These robots are envisioned to navigate space, orbiting Earth to perform critical tasks such as the repair and replacement of satellite modules amidst the backdrop of over 8,000 satellites and countless pieces of space debris, all in constant motion. Our objective is to create a robust framework for the orbital VRP that can accurately model and solve the route optimization problems inherent to servicing satellites in motion.

Contact:

Prof. Seokcheon Lee,
School of Industrial Engineering, Purdue University

Email: stonesky@purdue.edu. Website: https://engineering.purdue.edu/DClab/