SECURE for Student Success

**Undergraduate Research Program**

**Electrical and Computer Engineering Department**

**California State University Northridge**

**Research Duration:** Summer 2025 (June – August 2025)

**Faculty:** Rasoul Narimani

**Email address:** Rasoul.narimani@csun.edu

**Contact No:** Office: JD 4435, Telephone 818-677-7254

**Title of Project:** Building an Automated Framework for Analyzing Different Electric Vehicle Load Profiles on Power Electric Grids

**Goals and Objectives of the Project, Expectations, and Outcomes**

This project builds upon the 2024 foundational model of CSUN's electric grid in PowerWorld to develop a dynamic and automated framework for analyzing the impact of Electric Vehicles (EVs) on the power distribution system. Students will gain technical and analytical skills aligned with the project's advanced goals, particularly through automating and extending the model for time-varying scenarios. The overarching objective is to create an automated tool that seamlessly integrates EV load data, allowing for dynamic analysis of various load conditions. By linking PowerWorld with Python via Simulator Automation Server (SimAuto), students will learn to automate parameter adjustments, run simulations across multiple intervals, and assess the grid's response to EV loads, identifying weaknesses and proposing system enhancements.

## Goals and Objectives:

1. **Understanding Power Distribution Systems and Dynamic EV Modeling**
   Students will deepen their knowledge of power distribution systems, focusing on the challenges associated with integrating EVs under dynamic conditions. This involves extending the static 2024 model into a dynamic one where EV loads can be simulated across multiple intervals, enabling them to analyze the temporal impact of EVs on the grid over 15-minute increments for a full 24-hour period.
2. **Advanced PowerWorld Proficiency and Python Integration**
   Participants will gain hands-on experience in PowerWorld software, coupled with

advanced skills in Python for automation. By implementing SimAuto, students will learn to manipulate model parameters automatically, enhancing PowerWorld's functionality to allow seamless, interval-based adjustments. This exposure to high-level programming integrated with industrial software prepares students for automation and control tasks in the power systems sector.

3. **Automated Framework Development for Dynamic Analysis**
   The primary technical objective for 2025 is to build an automated system that supports dynamic analysis by running multiple EV load scenarios, adjusting parameters over time, and analyzing outcomes such as voltage profiles, power losses, line congestion, and system reliability. This approach allows students to work with time-series data, transforming the static 2024 model into a tool for dynamic power system studies.
4. **Impact Analysis and Grid Enhancement Recommendations**
   Through automated, interval-based simulations, students will assess how EV loads dynamically stress power distribution systems, identifying potential weaknesses that evolve throughout the day. By understanding these real-time challenges, they will propose grid enhancements and load management strategies to improve system reliability and efficiency.
5. **Report Writing, Data Analysis, and Publication**
   Throughout the project, students will refine their skills in documenting methodologies, analyzing large datasets, and preparing scientific reports. Their findings will be presented for potential publication in conferences such as TPEC, PECI, or NAPS, providing students with a professional platform to showcase their work.

## Learning Expectations and Outcomes:

This project extends well beyond conventional power system analysis, providing students with practical experience in dynamic modeling, programming, and time-series analysis. By automating parameters with SimAuto and PowerWorld, students will acquire skills essential for modern power system studies, including:

- **Automation and Dynamic Modeling**: Gaining hands-on experience with coding for dynamic, time-varying power systems modeling.
- **Programming and Software Integration**: Mastering Python for advanced integration with PowerWorld, preparing them for industry-relevant tasks in power system automation.
- **Time-Series Data Analysis**: Developing expertise in time-series data as they model load profiles and generation patterns across intervals, enhancing analytical skills critical for assessing grid performance under changing conditions.

Overall, the 2025 project represents a substantial advancement from the 2024 work, empowering students with deeper, hands-on experience in dynamic power distribution system modeling that mirrors real-world applications. By participating, students will not only understand the technical aspects of power systems but also gain practical programming skills and industry insights, equipping them for future contributions to sustainable and resilient energy solutions.