MINTernship Program

Transatlantic Energy Research Experiment

(TE-REx)

Research opportunities available at UNC Charlotte Summer 2026

General Contact

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Research Opportunities:

Project Title: Modeling and Simulation of HVDC Grids - Towards a Benchmark	
Energy Field Research Interest	Power Conversion and Power Electronics
Abstract of the project	This six-month research project will focus on developing and implementing dynamic models of key components for High-Voltage Direct Current (HVDC) transmission networks.
Tasks	The primary objective is to create a robust and computationally efficient simulation platform capable of analyzing the steady-state and transient behavior of multi-terminal HVDC (multi-terminal DC - MTDC) grids. The project will include: ● Component Modeling: Developing detailed mathematical models for Voltage Source Converters (VSCs), DC cables, and DC circuit breakers. These models will be adapted for real-time or near-real-time simulation environments. ● Grid Integration: Integrating the component models into a small-scale, representative MTDC grid topology. ● Simulation and Analysis: Conducting simulations to study critical operational scenarios, such as fault events (e.g., DC short circuits), power flow control, and the impact of different converter control strategies (e.g., droop control). The expected outcome is a validated simulation framework that provides insight into the stability, reliability, and control challenges unique to future HVDC meshed grids, laying the groundwork for further large-scale analysis.
Requirements	Electrical or computer engineering student with background in power systems modeling and simulation
Language Skills	Strong English Knowledge (B2-C1 English)
Software Skills	Experience with power system analysis software and with electromagnetic transient (EMT) simulation tools recommended
Other skills	
Duration of the project	up to six months (April – October)
Type of research project	Research Project
Responsible Professor	Valentina Cecchi (UNCC EPIC) and Giovanni De Carne (KIT)
Supervisor/Mentor of the project	Valentina Cecchi (UNCC EPIC) and Giovanni De Carne (KIT)
Supervisor`s Telephone Number	+1 704 687 8730
Supervisor`s Email	vcecchi@charlotte.edu and giovanni.carne@kit.edu
Faculty, Institute or Company Name	EPIC (UNCC) and Energy Lab (KIT)

Project Title: Agentic AI Cybergym for Integrated Power-Grid and DER Cybersecurity Testing	
Energy Field Research Interest (please select from one of the options below)	- Cybersecurity - Artificial Intelligence - Energy Systems
Abstract of the project	Research on cybersecurity, i.e. cyber-attacks and cyber-defense, requires testbeds (aka. labs, cyber-ranges, cybergyms) to develop and evaluate any approach. These testbeds are hard to construct: As models of complex real-world infrastructure, they have inherent limitations in fidelity, i.e. their explanatory power is capped to a limited number of use cases. The scientific models of cyber-attacks are lacking in particular due to missing technical details and the multi-domain knowledge required to build these systems. The versatility of Agentic AI challenges these model limits in particular so the scientific community is in dire need for more sophisticated representations of cyber-physical systems. The aim of this project is to create cybergyms for the two scenarios “cyberattacks on power system operators” and “cyberattacks on decentralized inverter-based resources”.
Tasks	• Getting familiar with Infrastructure as Code Tools • Getting familiar with the usage of Large Language Models • Design a network architecture for the scenario, pick configuration for nodes • Create images for the nodes • Design and test a simple attack chain manually • Design Capture-the-flag challenges for the AI to complete • Evaluate AI agents on these CTF challenges
Requirements	– Cybersecurity background would be nice, but not mandatory – Reasonable programming / software engineering skills
Language Skills	fluent in English

Software Skills	- nice to have experience in either:
	  o DevOps or Full Stack Development, or
	  o Windows administration at scale.
	- knowing how to navigate using a text console on a POSIX-based system.

Other skills	- willingness to learn about operational technology
Duration of the project	up to six months (April – October)
Type of research project	Research Project
Responsible Professor	UNCC: Prof. Dr. Meera Sridhar UNCC: Prof. Dr. Arun Ravindran KIT: Prof. Dr. Veit Hagenmeyer
Supervisor/Mentor of the project	UNCC: Prof. Dr. Meera Sridhar UNCC: Prof. Dr. Arun Ravindran KIT: Dr. Ghada Elbez KIT: Dr. Kaibin Bao
Supervisor`s Telephone Number	KIT: 0721 608-26917
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Faculty, Institute or Company Name	UNCC: Department of Electrical and Computer Engineering KIT: Institute for Automation and applied Informatics

Project Title	Digital Twin and Power Usage Optimization on Multiple Distribution Feeders
Abstract of the Project	The long-term goal of this project will be to focus on the development of a digital twin of several distribution circuits in Charlotte. The ultimate objective of this project is to deploy an optimization framework capable of dynamically modulating circuit-level power consumption in response to real-time grid conditions, with the goal of minimizing distribution losses and mitigating overload risks. Depending on network status and time requirements, various approaches are considered, including dynamic real-time pricing or robust hierarchical management techniques to increase efficiency while taking resilience into account. The long-term goal will be to include the selected circuits as part of a digital twin for the Charlotte region.
Tasks	For this stage of the project, we have the following tasks: • Working with the team at KIT to develop a basic digital twin of multiple Charlotte-area feeders. This digital twin for now will focus on visualization capabilities. • Working with distribution feeder models in open-source tools such as GridLab or OpenDSS to run basic power flows. **(Student at UNCC)** • Working on optimization schemes that adjust power demand using grid-edge resources (i.e. water heaters, EVs, and batteries) to meet grid needs **(Student at KIT)** • Both students will explore the use of FRAMESS (A platform developed at KIT) for the digital twin.
Learning Outcomes	*Describe the technical, methodological, and professional skills students are expected to gain.* • Sustainable modelling techniques for growing system models • Working with Agent- and network-based analysis & Decision Support Framework • Combining system modelling with system optimization • AI- & simulation-based optimization techniques
Requirements	Academic background, prior knowledge, skills *Specify relevant fields of study, coursework, and competencies.*
Language Skills	English
Software Skills	Some familiarity with either Java, Python or MATLAB
Other Skills	Familiarity with energy systems and specifically power systems
Fixed Duration of the Project	**At KIT:** 3 months (May 15-Aug 15)

	At EPIC: 6 months (April 1 – Sep 30)
Type of Research Project	Research Project
Expected Candidate Level	☐ Undergraduate ☐ Graduate
Location of placement	x KIT x EPIC
Responsible Professor UNCC	Robert Cox
Supervisor / Mentor	Phone number: 704-941-8006 Email: Robert.Cox@charlotte.edu
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Responsible Professor KIT	Daniel Banuti
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