Multiple funded Graduate Research Assistant (GRA) positions

in the areas of optimization & control with applications to sustainable, autonomous, and resilient power/energy systems (Electrical Engineering @ University of Vermont, Burlington, VT)

Are you mathematically curious? Do you want to be part of a highly collaborative and motivated team of researchers, solve real-world engineering problems, and advance technologies to enable a faster and more equitable clean energy transition? Do you have or are you soon completing a BS or MS in electrical engineering or a related field and are you wondering, “What’s next?”

If so, join us in Vermont! We are recruiting multiple PhD students to join the Electrical Engineering graduate program at the University of Vermont (UVM). With the support of multiple funding agencies and internal investments, we are actively recruiting multiple highly creative, motivated, and curious graduate students across a set of exciting research opportunities and projects. These opportunities span all areas of control and optimization with applications to sustainable, autonomous, and resilient power and energy systems. As part of a small, but mighty team, you will have a chance to impact critical areas of automation and sustainability. The GRA positions are fully funded 12-month positions for up to 4 years and include possible internship opportunities with world-class collaborators at national laboratories, academia, and industry. The expected start date is Fall 2023. **Underrepresented groups are strongly encouraged to apply.**

About UVM: Vermont has long been a leader in the renewable energy transition. Leveraging its strong connections with local utility companies and progressive industry partners, UVM (Vermont’s flagship research university) is building off many years of momentum generated by the power and energy system research groups at UVM and embarking on the ambitious goal of building up a new electrical energy research center.

Recommended background: an applicant should clearly demonstrate effective communication skills (written/verbal/visual), an ability to work independently in a larger team, and *experience with ≥ 2 o*f following:

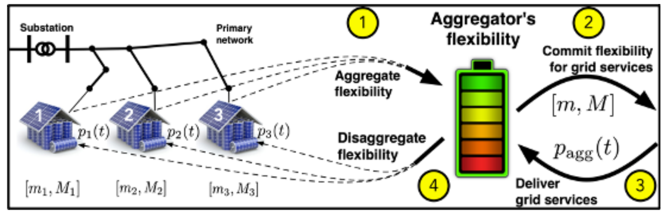
- Mathematical analysis (e.g., numerical methods, logic, dynamics, stochastic processes, learning)
- Power and energy system (e.g., AC load flow, OPF, load modeling, microgrids, DERs)
- Control systems (e.g., classical and modern control, stability analysis, predictive control)

To apply: We encourage you to reach out to us via email (see contact info below). Please use email subject header containing #**Fall2023GRA** and include the following:

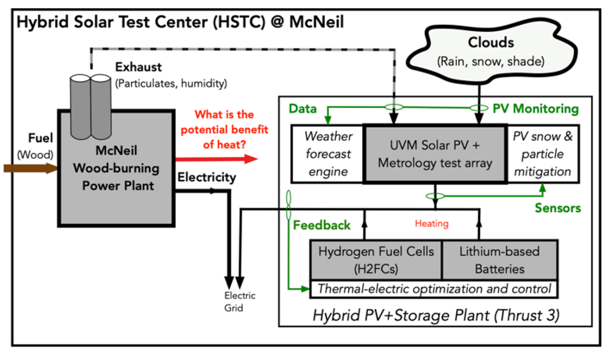
1. a concise statement about your research interests/experiences
2. describe which collaborative opportunity (see below) is of interest and how your experience aligns
3. your CV and unofficial transcripts along with any language scores

Preference will be given to applicants from underrepresented groups. For applicants whose language of instruction was not officially English, your **IELTS/TOEFL/DuoLingo score ≥ 7.0/100/120 to qualify for funding.**
To formally apply, please follow the application instructions here and check out the EE graduate program FAQ.

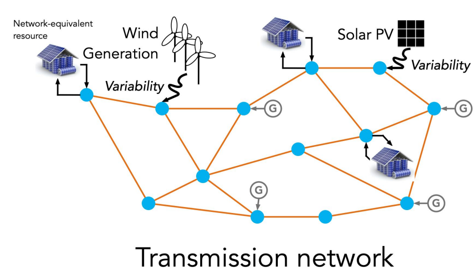
Overview of funded, collaborative research opportunities with EE faculty:



<u>Project opportunity #1</u>: *Network-aware Coordination of DERs with Operating Envelopes*. This project will bring transformative change to distribution system operations by developing novel paradigms for distribution grid operations and DER coordination. To achieve these goals, the project pursues three research objectives: *i*) Develop scalable optimization algorithms that enable the grid operators to dynamically maximize the capacity of distribution feeders to accommodate flexible demand, EV charging, and other DERs, while accounting for the nonlinear AC network physics, practical network topologies, legacy assets, and uncertainty; *ii*) Study (predictive) control algorithms that enable DER aggregators to deliver invaluable grid services while certifying that control actions are network-admissible; and *iii*) validate theory and analysis on a real-time grid+DER co-simulation platform. *<u>Key skills: power system operations, convex optimization, coding large grid/DER simulations, predictive control</u>*

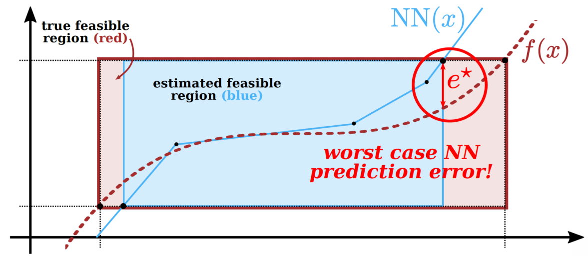


<u>Project opportunity #2</u>: Techno-economic Analysis of Hybrid Energy Systems. Hybrid energy systems (HES), which integrate different energy infrastructures (e.g., heat, energy storage, electric generation, inverters), can achieve greater energy and economic efficiencies than either element on its own. Tackling challenges associated with both fast (operational) and slow (planning and degradation) timescales in this project will enable a holistic techno-economic analysis of HESs that specifically considers thermal-electrical couplings. Thus, the project's outcomes will be (*i*) advanced modeling, control, and optimization tools for HESs across a range of temperature conditions and timescales suitable for operation and planning; (*ii*) hardware-based analysis and validation of these new tools in a lab setting via kVA-scale hardware-in-the-loop (HIL) platform and; (*iii*) field validation of the tools at a new Hybrid Solar Test Center (HSTC) in Burlington, Vermont. *<u>Key skills: predictive modeling & control, power systems, DER modeling, hardware experience, HIL validation</u>*

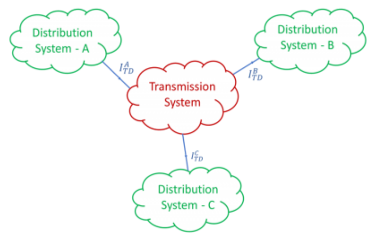


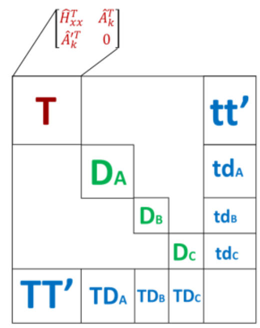
<u>Project opportunity #3</u>: Enabling Renewable Power Generation with Energysheds. Combining electrification efforts with smart algorithms engenders *intelligent electrification* of flexible, distributed energy resources, such as EV chargers, HVAC loads, batteries, and inverters, which can be responsive to incentive/control signals. But these signals must be cognizant of the complex interconnections between energy suppliers and consumers, power networks, energy resilience and economics, and environmental and social impacts. This project will focus on i) developing and analyzing optimal aggregations and coordination of DERs across different spatio-temporal scales in T&D networks; ii) study the trade-offs within a novel community *energyshed* framework; and iii) develop and validate simulation tools to quantify the trade-offs in a realistic setting.*<u>Key skills: power systems, cyber-physical systems, energy economics, predictive modeling and control.</u>*

<u>Project opportunity #4</u>: Machine Learning Performance Verification for Power and Energy Application. The “safety critical” nature of the power and energy sectors has prevented the wide scale adoption of machine learning (ML) in these fields, despite ML’s proposed benefits. To overcome this hurdle, this project seeks to develop strategies for rigorously computing worst-case performance guarantees for the ML models used in power and energy applications. Students working on this project will help develop optimization-based techniques which probe NN-based models in order to discover (i) regions of model inaccuracy, (ii) adversarial inputs which engender misclassifications, and (iii) inputs leading to surprising (yet accurate) predictions. *<u>Key skills: Machine Learning, Convex Optimization, Power Systems</u>*

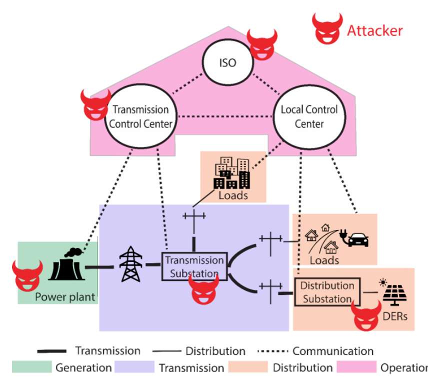


<u>Project opportunity #5</u>: Large-scale simulation and optimization of electric grids. Due to rapid decarbonization and electrification, large-scale simulations and optimizations of electric grids are becoming essential. Aspiring doctoral students interested in working on distributed parallel techniques for solving problems with millions of unknown variables are encouraged to apply to this project. *<u>Key skills: Numerical methods, Optimization, Power Systems, ML, Programming</u>*





<u>Project opportunity #6</u>: Developing analytical tools for improving grid cybersecurity. Including a large number of internet-connected devices makes the grid more efficient and automated, but it opens the electric grid to potential cyber-attacks. Aspiring students interested in developing analytical tools for more cyber-resilient power grids are encouraged to apply for this project. *<u>Key skills: Numerical methods, Security, ML, Programming, Power Systems</u>*



<u>Project opportunity #7</u>: Data-driven control of dynamical systems. The traditional controller design paradigm relies heavily on mathematical models of the system being controlled. However, with increasing complexity of dynamical systems (e.g., the power grid, transportation systems, soft robots, and complex hybrid energy systems), modeling is becoming a challenging task and the available models are too cumbersome for the purpose of control design. The goal of this project is to develop data-driven control theory and algorithms that allow us to compute control commands directly based on past data and recent measurements taken from the system. Specifically, we will use behavioral system theory to marry recent data-driven techniques with model-based techniques to obtain guarantees of stability, performance and robustness. <u>Key skills: Classical and modern control including state-space methods, linear algebra, Matlab programming.</u>

If you have any questions, we encourage you to contact us!

Mads R. Almassalkhi, Email: malmassa@uvm.edu
L. Richard Fisher Associate Professor in Electrical Engineering @ University of Vermont
Graduate Program Director in Electrical Engineering @ UVM
Chief Scientist @ Pacific Northwest National Laboratory (PNNL; Joint appointment)
Website | LinkedIn | Google Scholar

Hamid Ossareh, Email: hossareh@uvm.edu
Associate Professor in Electrical Engineering @ University of Vermont
Website | LinkedIn | Google Scholar

Amrit Pandey, Email: amritanshu.pandey@uvm.edu
Assistant Professor in Electrical Engineering @ University of Vermont
Adjunct Professor in Engineering and Public Policy @ Carnegie Mellon University
Website | LinkedIn | Google Scholar

Samuel Chevalier, Email: schevali@uvm.edu
Assistant Professor in Electrical Engineering @ University of Vermont (Incoming)
Website | LinkedIn | Google Scholar