Repurposing electric vehicle (EV) batteries for grid storage: Control methods for optimal operation of a mixed battery array

Fully-Funded PhD Graduate Student Opportunity

Summary:
This PhD graduate student opportunity in the Renewable Energy Storage Lab at Dalhousie University in Halifax, Nova Scotia, Canada is part of a multi-year $5M NSERC Strategic Network for Energy Storage. The project will use advanced model predictive control (MPC) with high resolution solar and wind forecasting to optimally operate a mixed battery array consisting of repurposed electric vehicle (EV) batteries.

Detail:
There are now well in excess of a million battery EVs driving the roads of the world, and these numbers a growing substantially every year. Each EV (e.g. Tesla Model S, Nissan Leaf, Chevrolet Volt) has a large battery pack that experiences wear throughout the life of the vehicle. After a period of time or operation (e.g. 15 years, 250000 km) the vehicle will likely be recycled. As an alternative to recycling, the EV battery can be re-purposed as very low cost stationary energy storage for the electricity grid.

We propose a *mixed battery array* consisting of a wide variety of re-purposed EV batteries (shape, thermal control, format, age) to be assembled in an industrial setting with isolated chambers and individual pack control. This design has strategic advantages over single pack type methods presently being employed by automotive OEMs. Advantages include a safe and controlled center for operations, regional aggregation of packs, and the ability to dispatch storage services calls to the most appropriate pack types.

Work completed to date by several students have characterized the used EV batteries and operated them according to the services promoted by the PNNL Protocols. Results to date indicate good performance, with significant variations between pack types and age.

A new control strategy is necessary to best utilize and operate the *mixed battery array*. It must take into account the various battery pack capabilities and conditions, and allocate service calls accordingly, including the forecast service calls and renewable energy resources. The Renewable Energy Storage Lab at Dalhousie University has collected numerous used EV batteries totaling several hundred kWh of storage. It has the necessary battery management systems (BMS) and high power and voltage battery cyclers to carry out experimental and control strategy.

We seek a PhD candidate to conduct a multi-year collaborative research project with a strong team from academia and industry. They will test and model a variety of EV batteries. They will create a stacked services control method and use model predictive control (MPC) to optimize it. They will then execute the control strategy on multi-channel power cyclers hooked to re-purposed EV packs to tune and validate the control system. The results of this research will be of great value to industry, as it grapples with the re-purposing of EV batteries and the need for electricity grid storage.

24 kWh BEV Pack

4 kWh Hybrid Pack

Position:
The PhD Graduate Student position is open to highly-qualified domestic and international students who hold a relevant Master's degree. Some experience with batteries, EVs, or MPC is required. Fluency in English language is required. The position is fully funded with an annual stipend of $25,000 for three years, beginning Winter 2017. Budget has been allocated to provide an office workstation and access will been granted to the powerful battery cycling equipment in the lab.

The successful candidate will be expected to publish research results, attend conferences (funded), and mentor junior research team members. This intensive research period will be carried out under the supervision of Dr. Lukas G. Swan, a knowledgeable and experienced battery storage research engineer.

Interest-application Submission:
Interested parties should submit an interest-application for this position to the below email address. The interest-application should include: cover letter, statement of research interest, detailed curriculum vitae, recent academic transcripts, and an authored manuscript/article that demonstrates the applicant's research quality.

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About Dalhousie University:
Dalhousie is Atlantic Canada's leading research university, attracting over $132 million in research grants and awards each year. Its researchers are nationally and internationally recognized for their work. Our researchers are exploring a number of areas including: ocean studies; advanced materials and clean technology; health and wellness; governance; society and culture; information science and communication; agriculture and food technologies; energy and the environment. Dalhousie has four campuses, spread throughout peninsular Halifax and Truro, occupying more than 32 hectares (79 acres)
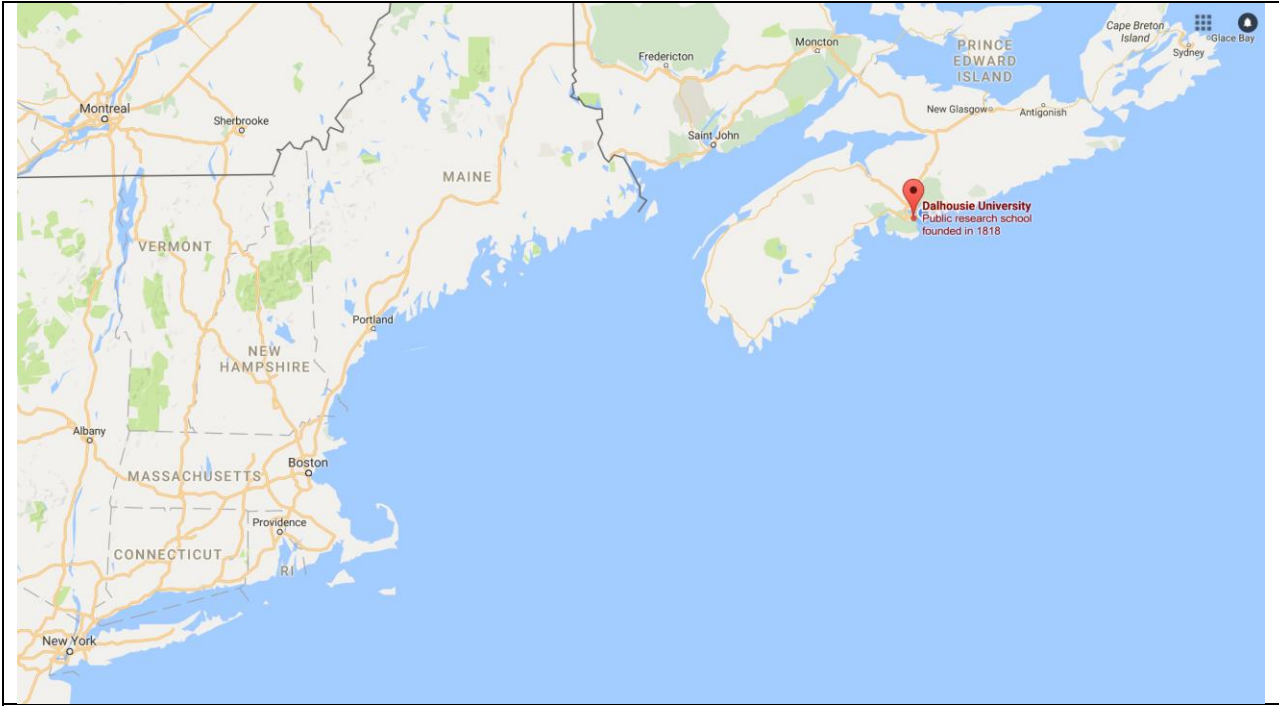
of land. Surrounded by a primarily residential area, the university rests in the heart of Halifax, close to the city's major amenities.

Dalhousie University

Halifax Harbour (novascotia.com)

Geographic Location