AIMS^2 Research Project in Battery Energy Storage Systems in Renewable Energy Systems

Research Duration:	Summer 2020 (June – August 2020)
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Title of Project:	**Battery Energy Storage Systems in Renewable Energy Systems**

Battery Energy Storage Systems in Renewable Energy Systems

Battery Energy Storage Systems (BESS) include lithium-ion, sodium sulfur, electrochemical battery, flywheel, compressed air, superconducting coil, advanced lead-acid, and flow batteries. Lithium-ion battery and advanced lead-acid batteries technologies are used mainly in transportation (such as electric vehicles and public transportation). Renewable Energy Systems (RES) can utilize any of the BESS, improving microgrid reliability.

EV (electric vehicles) around the world have been in exponentially increasing demand in the past three years. The cost of BESS for transportation has declined, which has boosted mile range. We are also at the early stages of increasing demand for electric SUVs, light pickup trucks, public buses. For example, City of Los Angeles just bought 150 all electric public buses. Tesla has a commercial ESS (energy storage system) behind-the-meter residential system with a capacity between 5KWH to 30 KWH. For commercial systems, the capacity is between 20 KWH to 1MWH and for Utility level from 1 MWH to 100 plus MWH.

Lithium-ion batteries utilized in EV are expected to drop in price in the next decade by 6.5% [1]. Other ESS are mostly used in grid level systems. A decrease in pricing is forecasted for stationary ESS based on duration and capacity.

In addition, Distributed Renewable Energy Sources (DRen) power local rural communities offering "on-site" generation. This is quite important since this year developing countries will have achieved the doubling of their power output compared to 25 years ago.

ONLINE RESEARCH: This project will be done online using CSUN Matlab/Simulink, LAbView student version and Databases provided by CSUN's library (IEEE-Xplore, Elsevier, etc). All students have access to Matlab via CSUN download, and LabView student version or demo version is free from LabView.

Goals:

1. Literature research (2.5 weeks)
2. Lithium-Ion and Lead-acid batteries modeling with MATLAB/Simulimk (2.5 weeks) or/and LabView
3. Smart grids and distributed renewable energy sources (DRen) (2.5 weeks)
4. ESS in micro grids (2.5 weeks)

Outcomes:

1. Modeling of Lithium-ion and Led-Acid batteries
2. Report in Microsoft word
3. Power Point presentation
4. IEEE-Template based research paper

The team for this research will be composed of three to four CSUN-AIMS2 students. Those students are expected to work every week up to a maximum of 10 hours/week. Every week we will have a mandatory meeting via Zoom to show progress achieved, for each of the goals listed above working towards the intended outcomes. Towards the end of summer, students will finalize a technical paper related to their findings using the IEEE technical paper format as well as prepare a poster. These will be presented during the annual research symposium to be held in spring 2021.

A CANVAS site will be set up for this project. On the Canvas site, each goal will be set up as an assignment. In each assignment, students will have to identify their individual contributions. A rubric will be set up for each assignment in which how well the submissions meet the expectations for individual outcomes will be assessed. Students will get feedback for improvement from me using feedback tools on Canvas. The group will use the discussion forum on Canvas for daily updates on their work.

[1} Advanced Battery Innovations Navigant