Degradation detection and localization in battery packs

Supervising team

Michel Kinnaert and Maxime Bussios, Michel.Kinnaert@ulb.ac.be, Maxime.Bussios@ulb.be, SAAS, ULB

Context of the work:

Renewable energies and electric transportation are the cornerstones for developing a sustainable future society. Energy storage is fundamental in this context, in order to store surplus of energy and use it when the wind does not blow or the sun does not shine, or to produce vehicles that do not pollute the environment when they are on the roads.

Among the possibilities, lithium-ion batteries are the technology of choice given their high energy capacity and efficiency. However in contrast with other battery technologies, the benefits of lithium-ion batteries come at the price of careful monitoring requirements. Indeed, faulty cells in a battery pack can have catastrophic consequences including fire.

Objective of the thesis

The objective of this thesis is to develop a monitoring system that is able to detect and localize the degraded or weak cells within a pack on the basis of available voltage, current and temperature measurements. Both synthetic data obtained from a realistic battery pack simulator, and real data recorded on a 4-cell battery pack will be exploited to determine features that can be extracted from the measurements, or from combinations of measurements, and that exhibit pack malfunction. Next, appropriate classification tools will be investigated in order to decide on the healthy or degraded state of the pack and to localize the degraded cell/cells by processing the features extracted from the measurements. Various degradation levels and types will be considered in order to characterize the sensitivity to each fault.

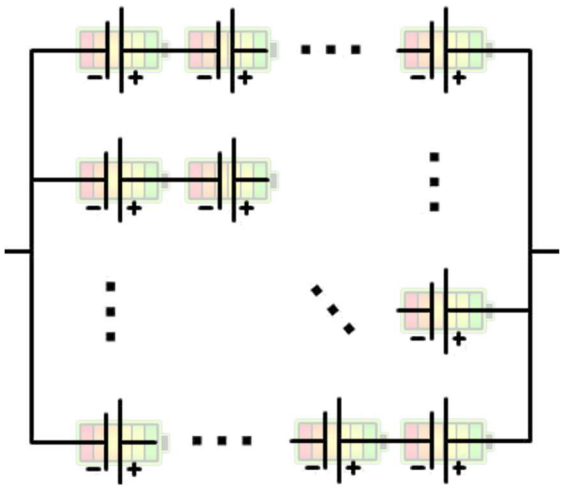

Figure 1. Battery pack.

Work to be done

The student should

1. perform a bibliographic search on fault/degradation diagnosis for battery packs,
2. generate synthetic data for heathy pack operation and for various degradation types and levels,

3. Use measurements and/or appropriate functions of the measurements to generate features that exhibit faulty/degraded behaviour,
4. Develop a classification method that decides on the pack state by processing the features extracted from regular measurements.