Universität Stuttgart - Institute for Modeling Hydraulic and Environmental Systems
Department of Hydromechanics and Modelling of Hydrosystems
Independent Junior Research Group: Stochastic Modelling of Hydrosystems
Prof. (jun.) Dr.-Ing. Wolfgang Nowak, M.Sc.

„Thermal Runaway of Lihtium-Ion Batteries"

Master's (or Batchelor's) Thesis

The realization of innovative energy concepts requires efficient solutions for the storage of electric energy. Due to their high energy density, the already widespread Lithium-ion batteries are one of the most promising technologies in this regard. Unfortunately, the high energy density entails a high destruction potential in case of failure. If the battery is damaged or abused, a self-accelerating reaction, which is referred to as "thermal runaway", may cause the battery to catch fire or even to explode. Numerous recalls of rechargeable batteries by well-known manufacturers show the importance of this problem.

Numerous scenarios can lead to a thermal runaway. In the scope of this project some of these scenarios will be investigated with an already established battery model. Several model parameters and battery properties will be statistically varied (Monte Carlo simulation) to detect the critical range of the parameter values and to quantify the uncertainty inherent in the simulation. The gained insights into the system will then be used to give design suggestions to allow for the building of more robust batteries in the future. In summary, the required work steps comprise:

- Investigation of the probability of the respective runaway scenarios.
- Conduction of a sensitivity analysis of this probability with respect to different parameters.
- Suggestions for an improved battery design that increases the robustness of the battery against the respective runaway scenarios.

The final thesis should be submitted within six months after the start date. For batchelor students it is possible to work only on a small part of the project. The earliest possible start date is 2014-07-01

For a successful completion of the thesis we expect the following points to be important:

- Some programming experience (ideally MATLAB)
- Experience/basic knowledge in one or more of the following areas: thermodynamics, statistics, simple numerics, batteries, mechanical/chemical process engineering

If you are interested in this project, we would love to hear from you!

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