Masters Thesis Defense Announcement

Mechanical and Aerospace Engineering Department
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Submodeling approach for computationally-efficient thermal simulations of large Li-ion battery packs

By

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Abstract

Li-ion batteries offer high energy density and good cycling performance, and are commonly used for energy storage and conversion, such as in electric vehicles A key requirement to ensure good performance is the ability to accurately predict the thermal response of the battery pack to heat generation during operation. Numerical simulations of large battery packs may take a long time due to geometrical complexity arising from thousands of cells in a typical pack. In this work, the sub-modelling approach is used for time-efficient numerical analysis of Li-ion battery packs. It is shown that submodeling can be used for reducing the computational time without significant impact on accuracy. The trade-off between simulation time and accuracy is analyzed through a series of simulations. The submodeling approach is used for predicting the thermal performance of a large battery pack comprising more than 6000 cells at multiple discharge rates and under multiple cooling conditions. Transient power simulations were also carried out using this technique to prove that having copper connectors improve the thermal response of these packs. It is expected

that the results from this work may be helpful for improving the capability to model and predict temperature rise in Li-ion battery packs.

Keywords: Li-ion cells, CFD analysis, sub-modelling technique, thermal management.

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