Modelling Thermal Effects of Battery Cells inside Electric Vehicle Battery Packs

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Introduction: The poster presents a methodology to account for thermal effects on battery cells to improve the typical thermal performances in a pack through heating calculations generally performed under the operating condition assumption. The aim is to analyse the issues based on battery thermo-physical characteristics and their impact on the electrical state of battery cells(Khan, Mulder et al. 2013, Khan, Andreasen et al. 2014, Khan et al. 2014, Khan, Mulder et al. 2014, Khan, Nielsen et al. 2014). Based on this analysis, we derive strategies in achieving the goal, and then propose a battery thermal management system with cell-level thermal controls.

Computational Methods: To achieve this, a 3D FEM model of a simplified battery pack is solved in COMSOL Multiphysics with the time varying heat source with different flow rates and in two different cell orientations. The Heat equation is used to model the pack and the classical cooling media e.g. Air and Liquid for the battery pack is implemented.

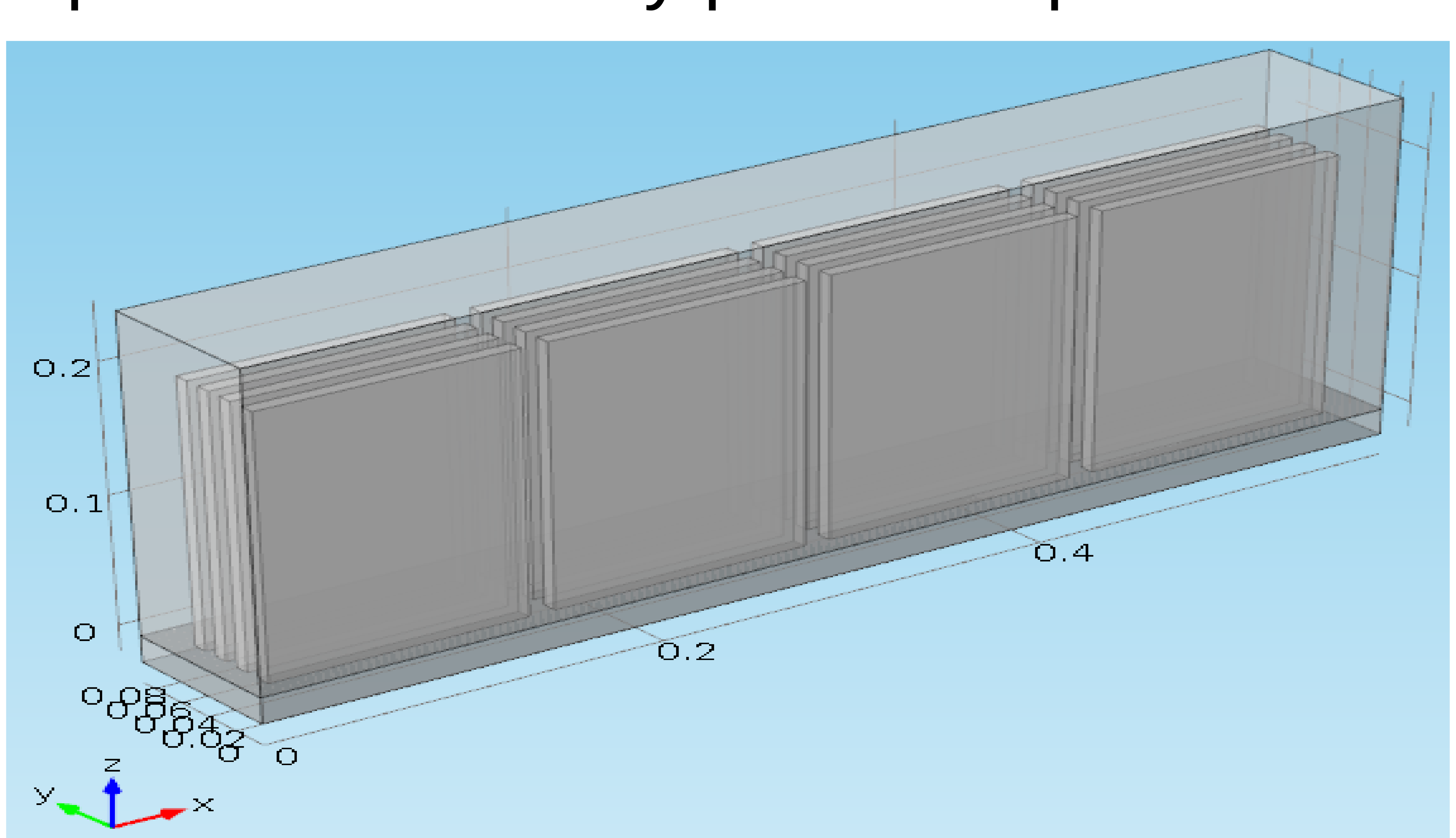

Figure 1. Pack Design

Results: Fig. 2 illustrates the cooling of a battery module discharged with a high current rate. For cooling purposes, a 0:024 kg/m2.s air flux is entering at 25° C on the inlet side of the module.

Results: At the end of the discharge, Figure indicates lower temperatures (around 25° C) at the front and higher temperatures (around 30° C) at the rear of the module. Therefore, Figure emphasises the need for a sufficient inlet air velocity for a proper thermal management of the cells located in the rear of the module.

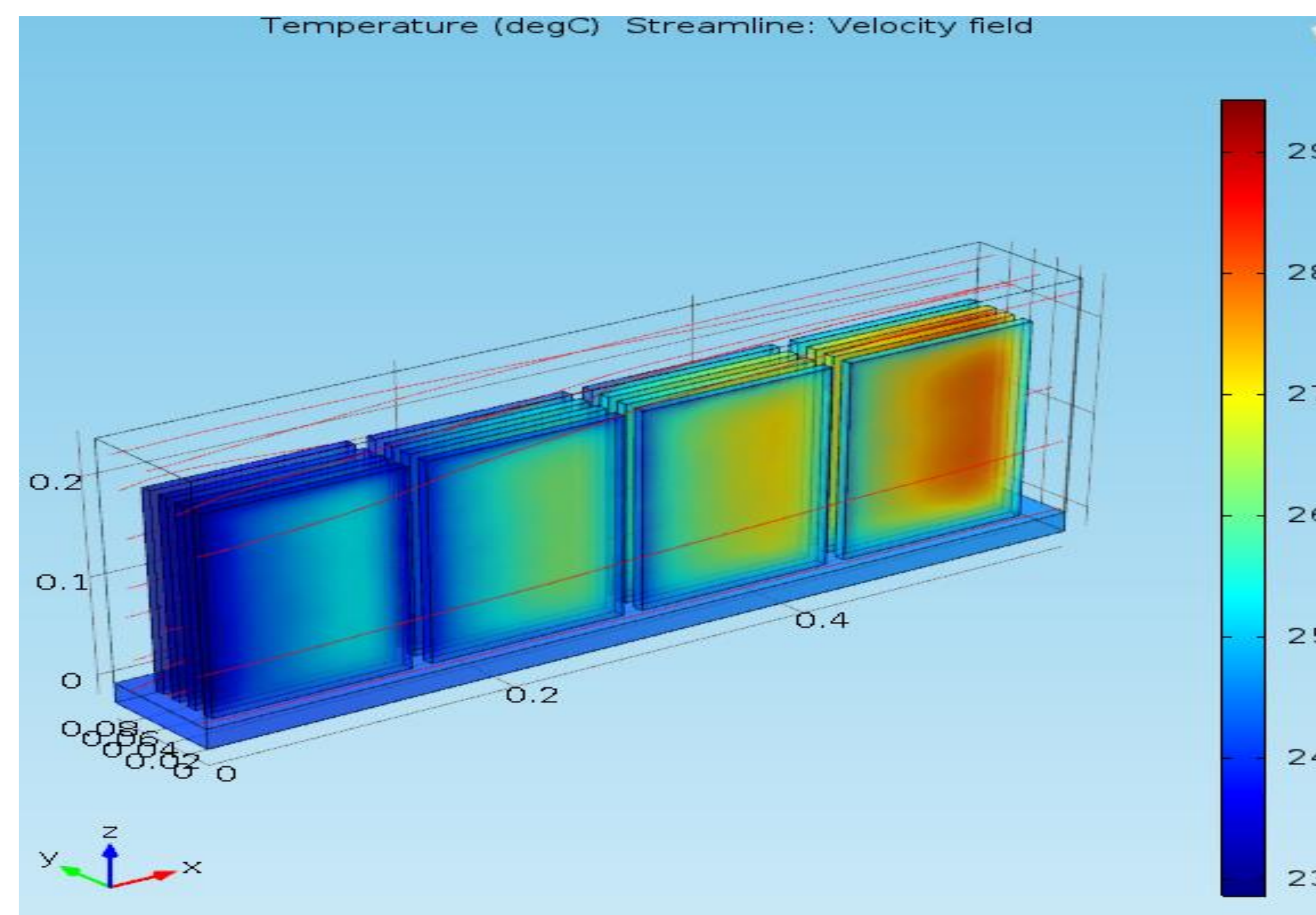

Figure 2. Temperature distribution.

Conclusions: Since, the 3D approach appears necessary when other more complex geometric configurations have to be taken account it poses somewhat futureproof solution.

References:

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