

Large and High Power Cylindrical Batteries – Analysis of the Battery Packs Temperature Distributions Using COMSOL Multiphysics® and MATLAB® Simulation Softwares

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COMSOL
CONFERENCE
2014 CAMBRIDGE

Presentation outline

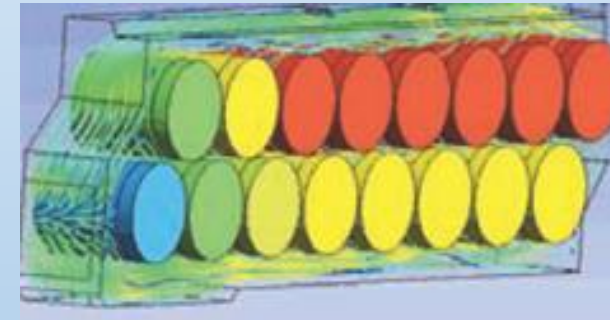
1. Why the analysis of the battery packs temperature distributions ?
2. Modelling approach
3. Results and discussion
4. Conclusions

1. Why the analysis of the battery packs temperature distributions ?

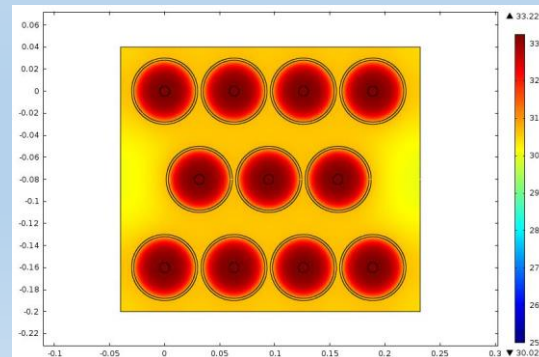
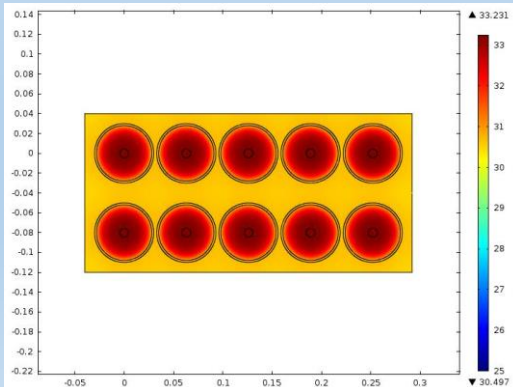


... To prevent thermal abuse

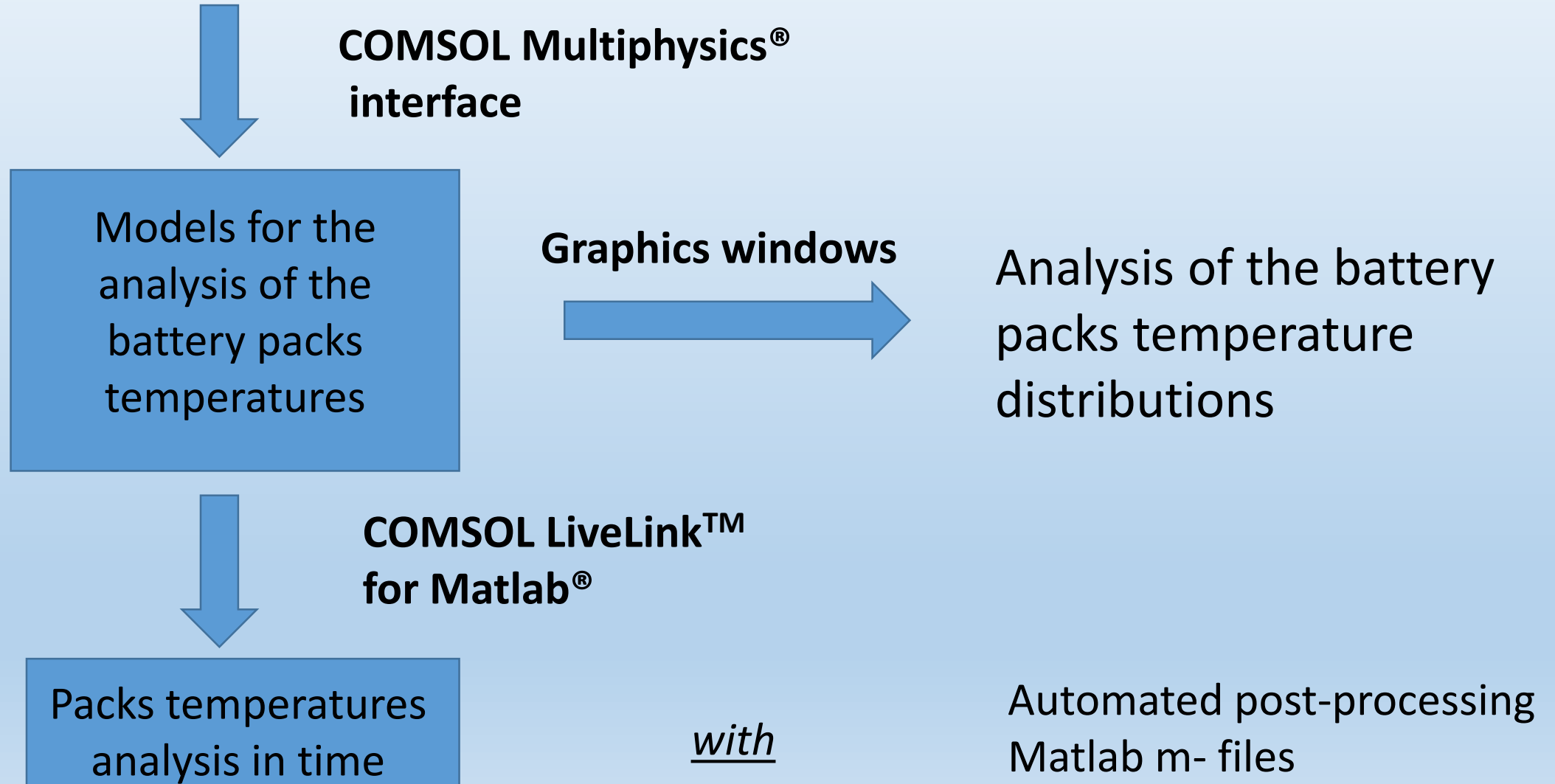
... To achieve good cooling and heating



... To assess the thermal performances

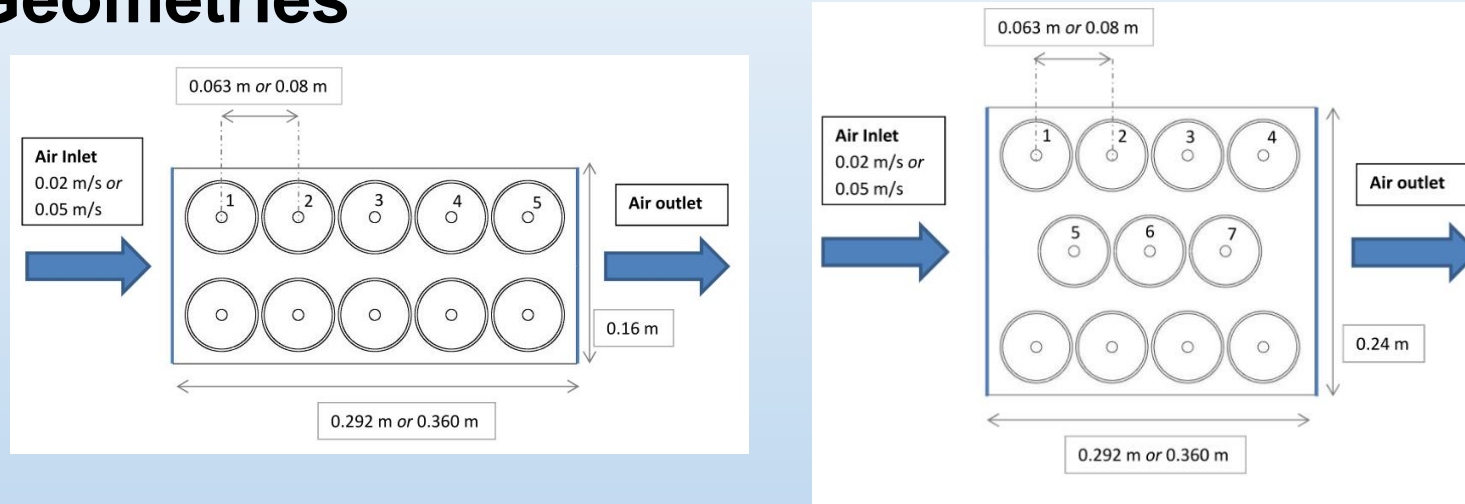


2. Modelling approach (1/2)



2. Modelling approach (2/2)

- Geometries**



- Physics and material properties**

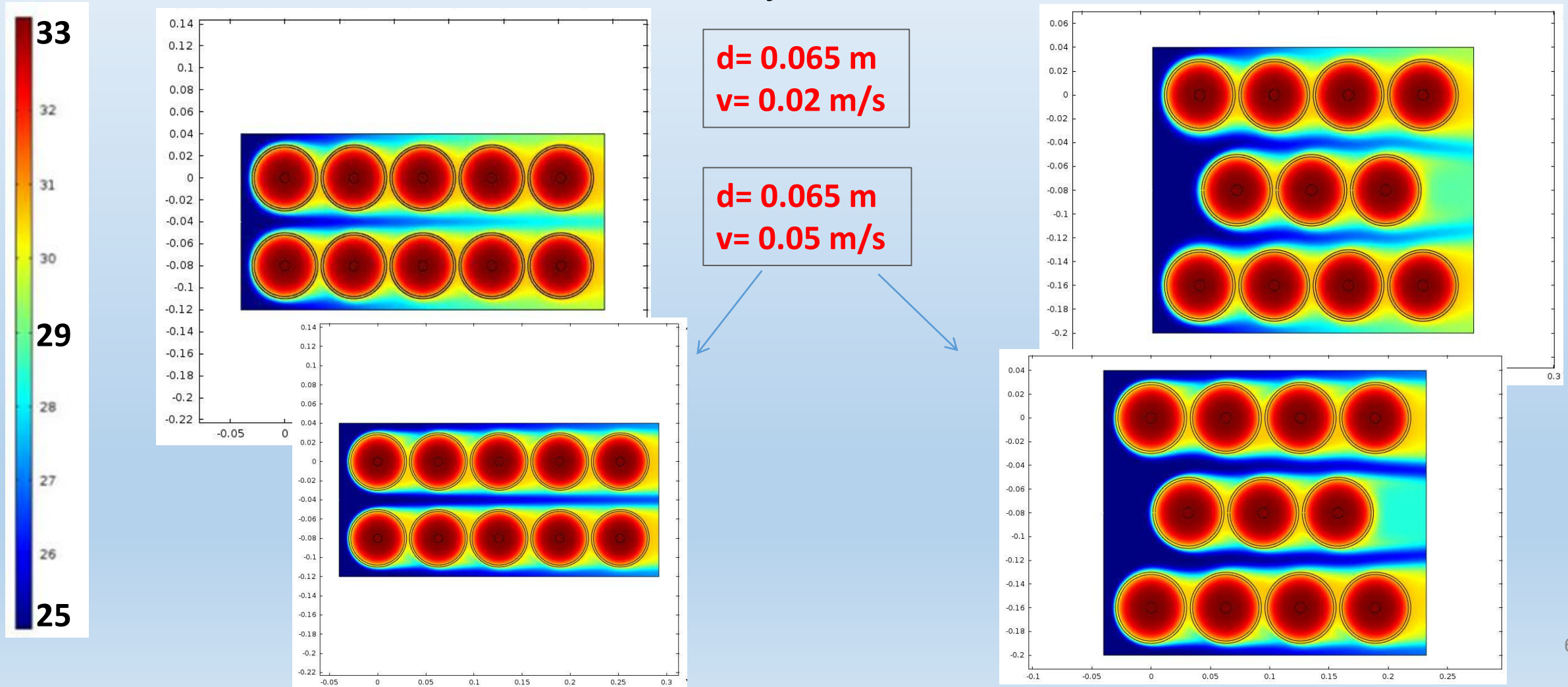
	Closed pack	Open pack
Physics	<i>Heat Transfer in Solids</i>	<i>Conjugate Heat Transfer</i>

Material	Properties	Value
Air (Gas)	ρ , [kg/m ³]	Defined by piecewise functions dependent on the temperature
	C_p , [J/kg.K]	
	k , [W/m.K]	
Steel AISI 4340	ρ , [kg/m ³]	7850
	C_p , [J/kg.K]	475
	k , [W/m.K]	44.5
Battery active material	ρ , [kg/m ³]	3345.5
	C_p , [J/kg.K]	1034.2
	k , [W/m.K]	0.33434

- Mesh** → a free triangular mesh (maximum element size of 0.000402 and minimum element size of 1.8E-4)

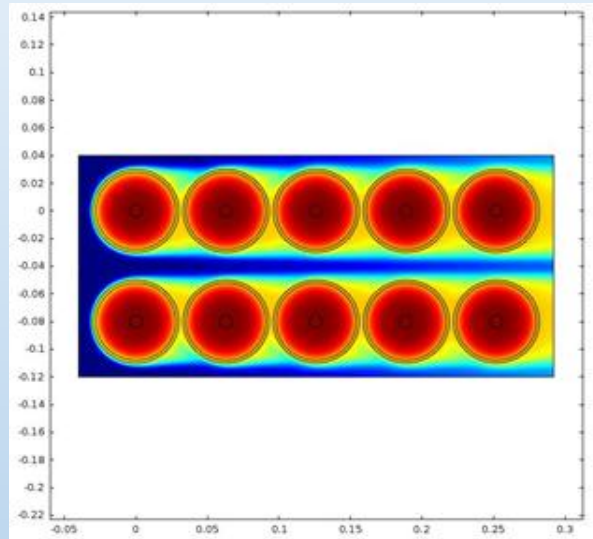
3. Results and discussion (1/3)

- Influence of the air inlet velocity

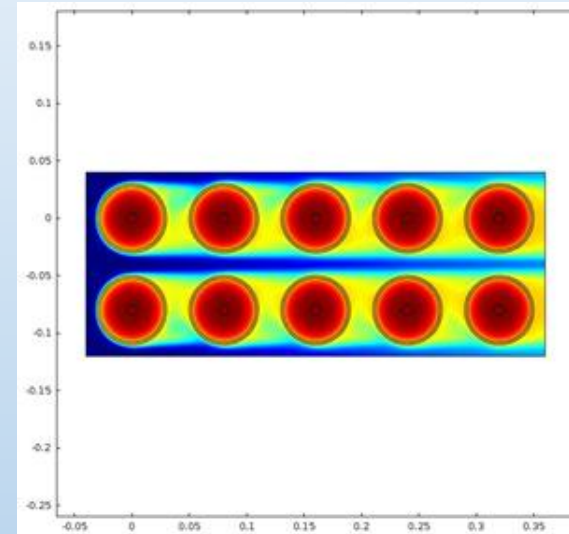


3. Results and discussion (2/3)

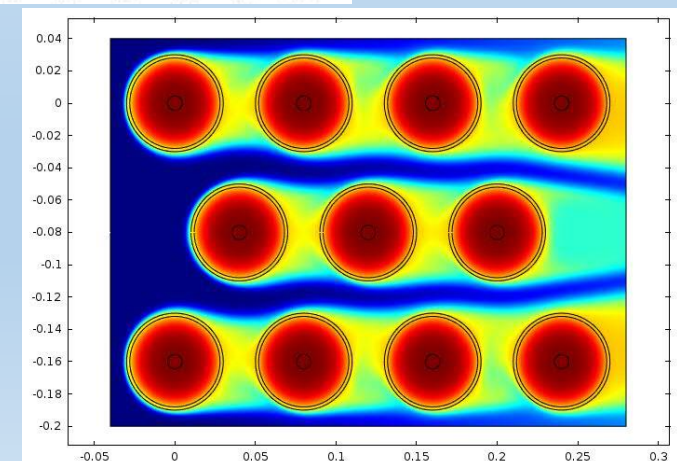
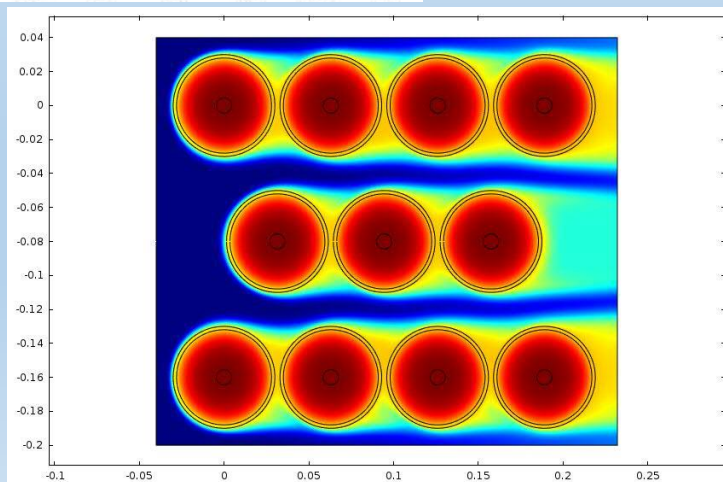
- Influence of the distance between consecutive cells



$d = 0.065 \text{ m}$
 $v = 0.05 \text{ m/s}$

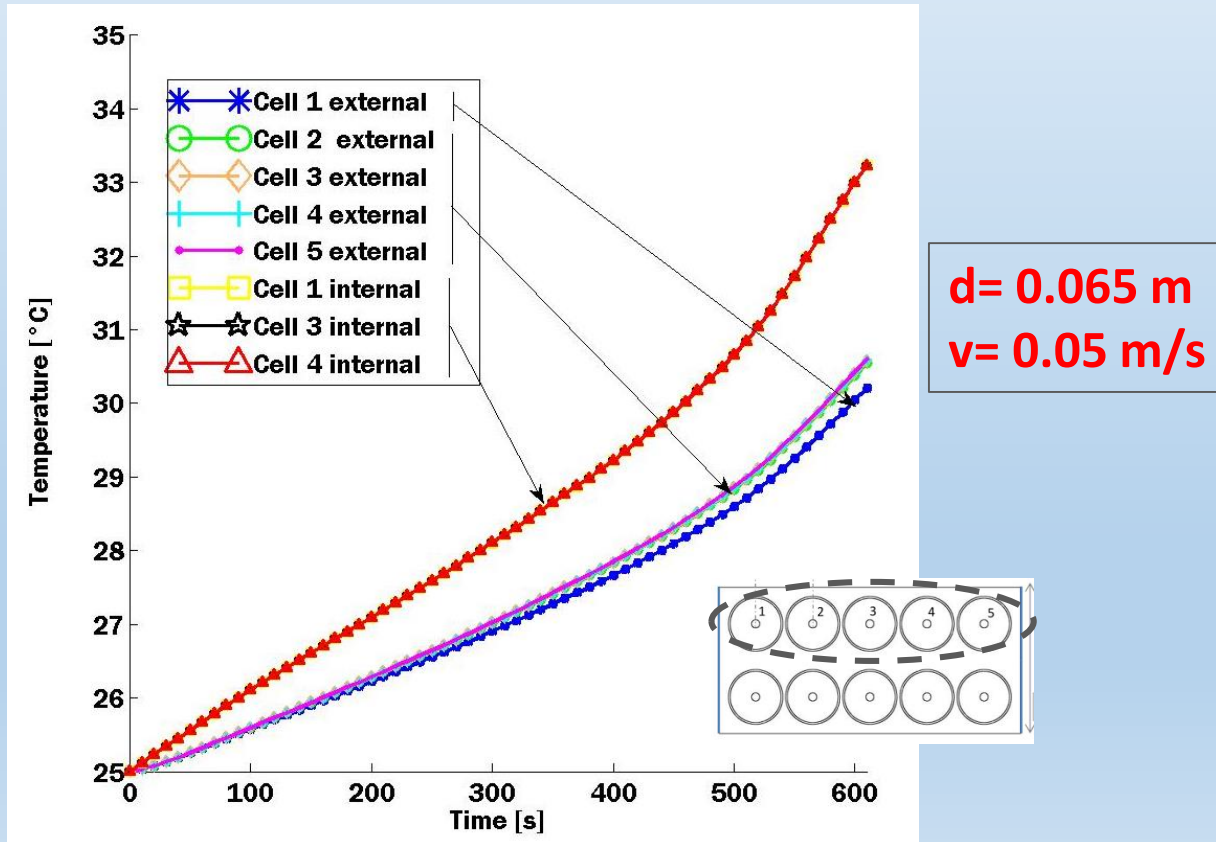


$d = 0.08 \text{ m}$
 $v = 0.05 \text{ m/s}$

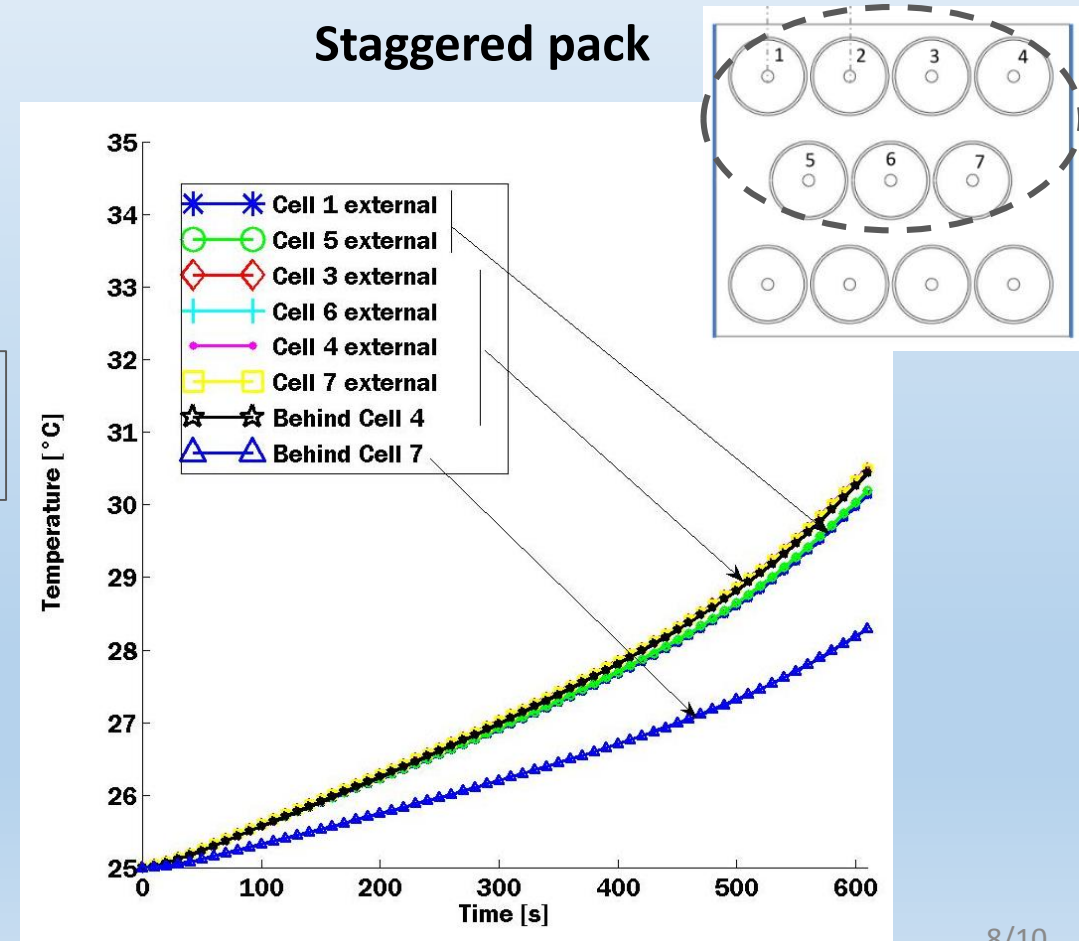


3. Results and discussion (3/3)

Cells temperature in time In-line pack



Cells temperature in time Staggered pack



4. Conclusions

- **A two dimensional thermal analysis of cylindrical battery packs** was achieved with **COMSOL Multiphysics®** (*considering the greater thermal conductivity in the longitudinal compared to the radial direction*)
- **LiveLink™ for Matlab** was used for **post-processing** the simulations results (*in an automated and flexible way*)
 - **The greatest temperatures** were observed **inside the cells.**
 - **Increasing the air inlet velocity** allows for an **improved cooling** of the cells at the **rear** of the **packs.**
 - **Increasing the distance between the cells** allows the air to flow in between the cells but **does not reduce** significantly the **cells internal** nor **surface temperatures.**

Thank you for your attention!

Questions



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