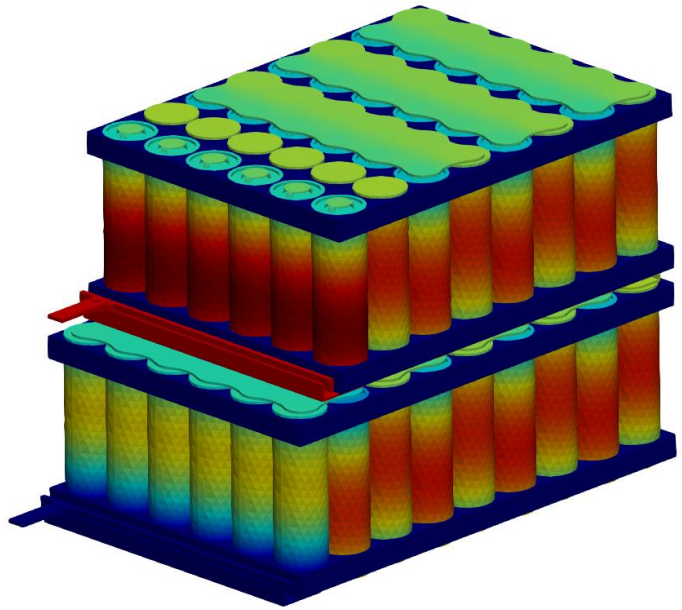
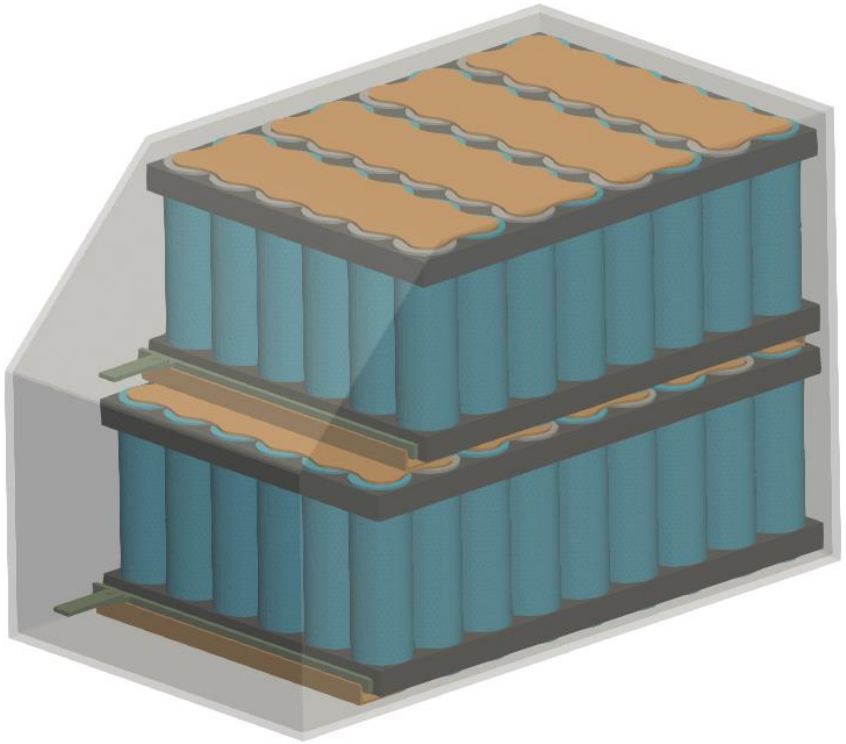
QUICKERSIM



Heat transfer in e-motorbike’s battery pack

QUICKERSIM

Overview of model



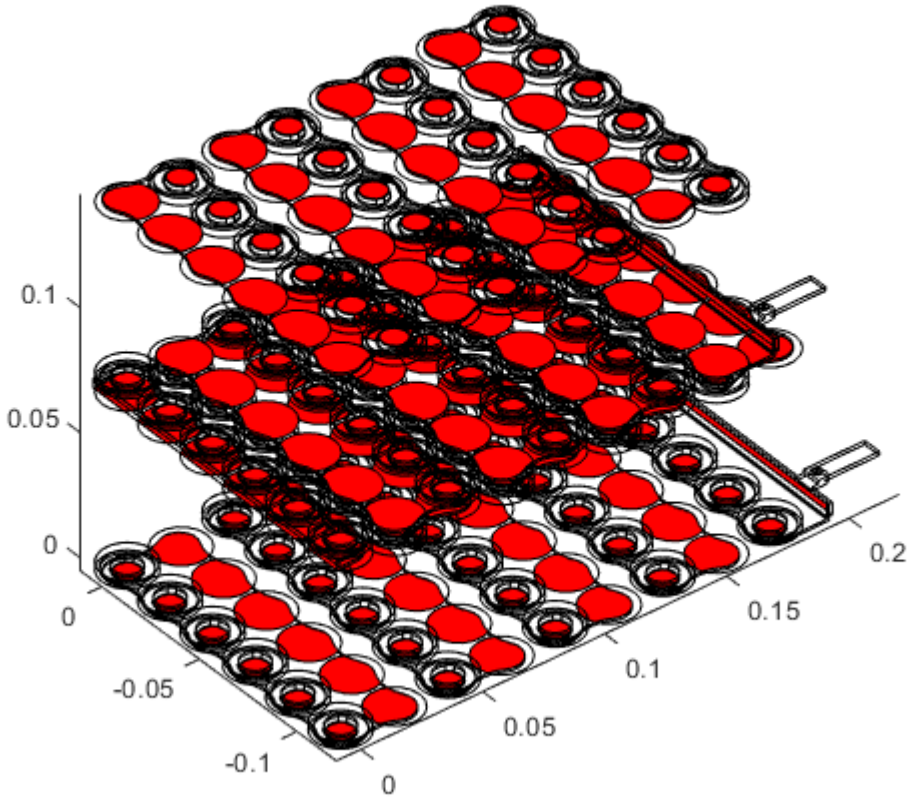
This use-case example presents how to perform simulation of heat transfer in a e-motorbike's battery pack in Q-Bat software.

The model consists of 102 Li-ion 21700 cells (17s6p), terminals, connectors, holders and casing.

Current profile, boundary and initial conditions are selected to simulate e-motorbike riding in the city in India during a summer day.

QUICKERSIM

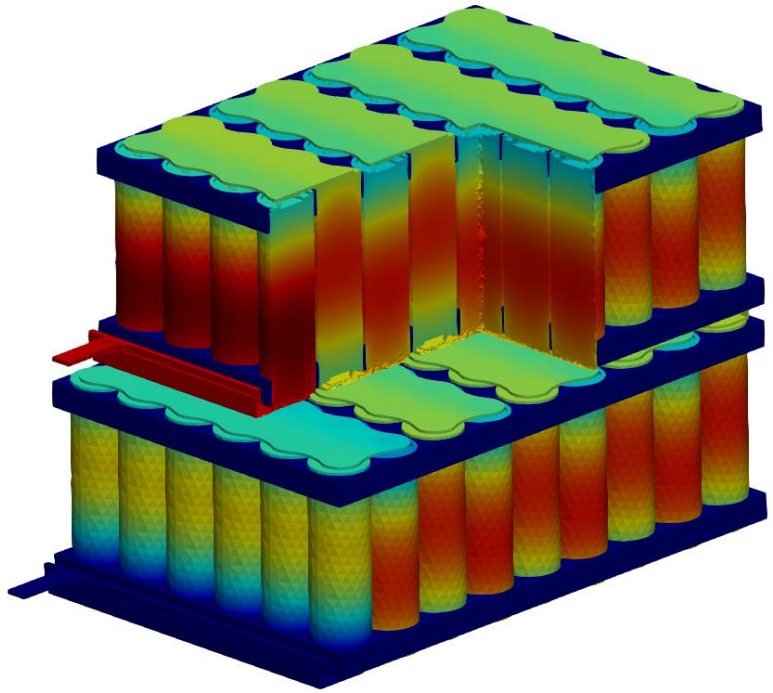
Model assembly



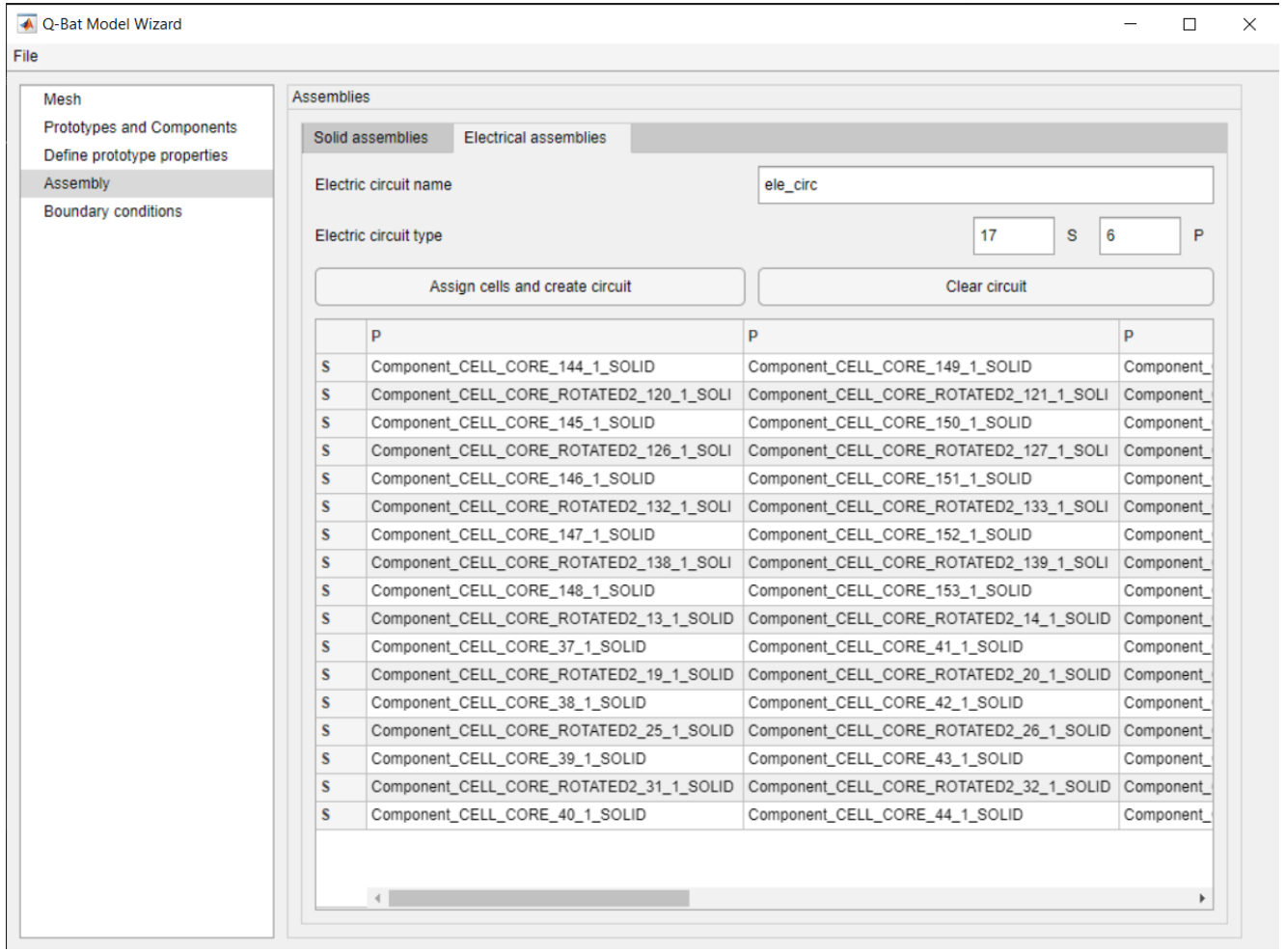
- All components are aggregated in one assembly and contact regions between tchem are created.
- To simulate thermal pad the contact conductivity and the contact thickness are specifed.

Thermal model

- Heat generated uniformly across cell volume
- A domain of air inside the casing is modelled as a passive heat component with artificial deflation of its thermal conductance
- Robin boundary condition is assigned to the casing outer boundaries.



Electric circuit



	P	P	P
S	Component_CELL_CORE_144_1_SOLID	Component_CELL_CORE_149_1_SOLID	Component_
S	Component_CELL_CORE_ROTATED2_120_1_SOLI	Component_CELL_CORE_ROTATED2_121_1_SOLI	Component_
S	Component_CELL_CORE_145_1_SOLID	Component_CELL_CORE_150_1_SOLID	Component_
S	Component_CELL_CORE_ROTATED2_126_1_SOLI	Component_CELL_CORE_ROTATED2_127_1_SOLI	Component_
S	Component_CELL_CORE_146_1_SOLID	Component_CELL_CORE_151_1_SOLID	Component_
S	Component_CELL_CORE_ROTATED2_132_1_SOLI	Component_CELL_CORE_ROTATED2_133_1_SOLI	Component_
S	Component_CELL_CORE_147_1_SOLID	Component_CELL_CORE_152_1_SOLID	Component_
S	Component_CELL_CORE_ROTATED2_138_1_SOLI	Component_CELL_CORE_ROTATED2_139_1_SOLI	Component_
S	Component_CELL_CORE_148_1_SOLID	Component_CELL_CORE_153_1_SOLID	Component_
S	Component_CELL_CORE_ROTATED2_13_1_SOLID	Component_CELL_CORE_ROTATED2_14_1_SOLID	Component_
S	Component_CELL_CORE_37_1_SOLID	Component_CELL_CORE_41_1_SOLID	Component_
S	Component_CELL_CORE_ROTATED2_19_1_SOLID	Component_CELL_CORE_ROTATED2_20_1_SOLID	Component_
S	Component_CELL_CORE_38_1_SOLID	Component_CELL_CORE_42_1_SOLID	Component_
S	Component_CELL_CORE_ROTATED2_25_1_SOLID	Component_CELL_CORE_ROTATED2_26_1_SOLID	Component_
S	Component_CELL_CORE_39_1_SOLID	Component_CELL_CORE_43_1_SOLID	Component_
S	Component_CELL_CORE_ROTATED2_31_1_SOLID	Component_CELL_CORE_ROTATED2_32_1_SOLID	Component_
S	Component_CELL_CORE_40_1_SOLID	Component_CELL_CORE_44_1_SOLID	Component_

- 17 cells connected in series and 6 cells in paralel
- Heat generation is set by specifying the electrical properties of the cell (capacity, voltage, resistance) and applied current load, that varies in time
- Cells are modelled as R circuits
- Heat is generated as uniform distribution in the cell

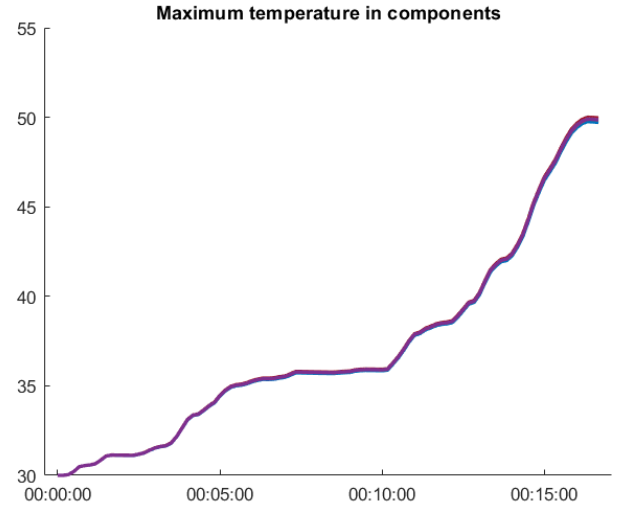
QUICKERSIM

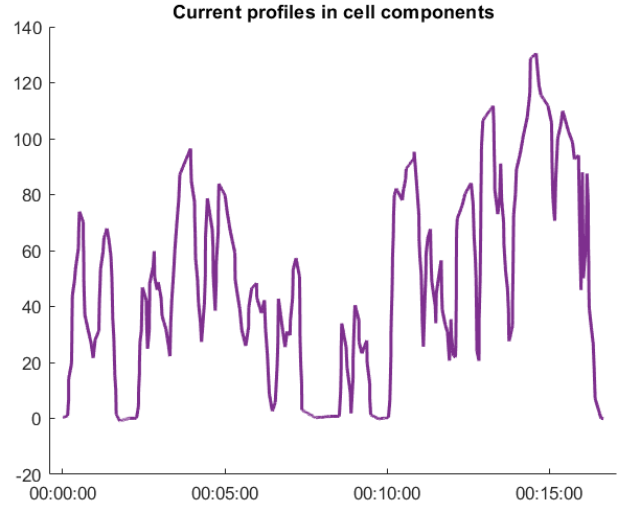
Prototype properties

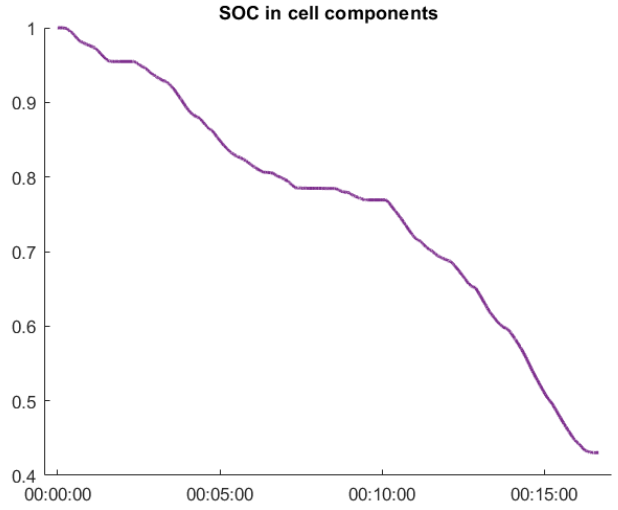
- Material properties of the cells and heat comoponents are defined in an Excel spreadsheet

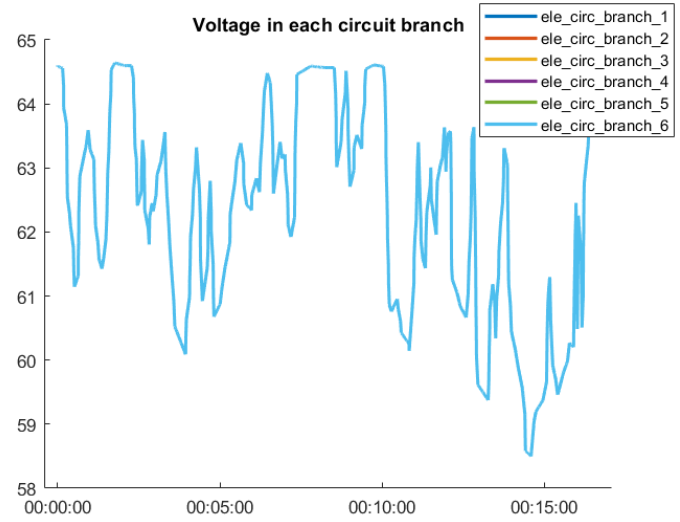
Part	rho	cp	λ_ϕ	λ_r	λ_z
Cell	2700	1280	28.05	3.4	28.05
			λ_x	λ_y	λ_z
Casing	1055	1300	0.185	0.185	0.185
Connector	890	385	397	397	397
Holder	1055	1300	0.185	0.185	0.185
Terminal	2690	901	238	238	238

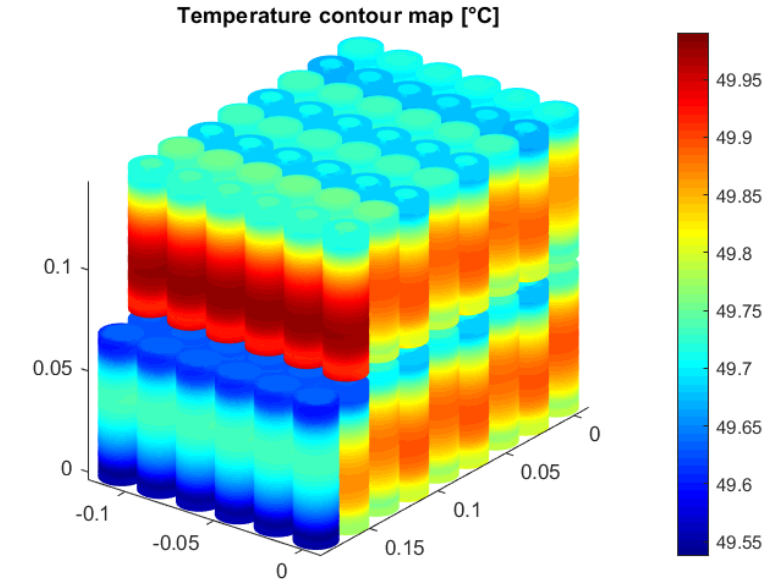
Simulation results











QUICKERSIM

Summary

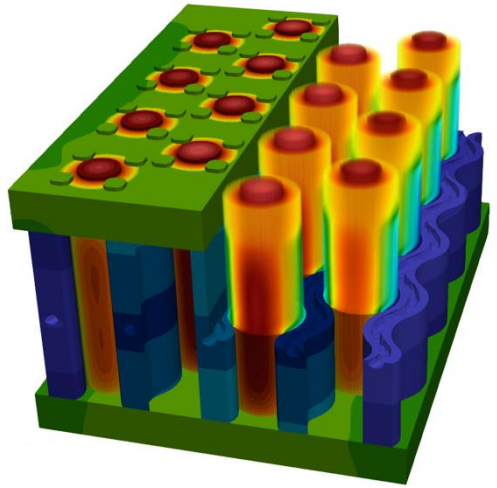
The model consists:

- 9 prototypes,
- 229 components,
- 815 581 mesh elements,
- 614 contacts regions.

The simulation time is only **12 minutes**.

Learn more

- Q-Bat is a MATLAB-based product for real-time battery thermal simulation in 3D with CFD-like accuracy. Its main features are:
  - Near real-time execution
  - Accurate 3D data of battery temperature distribution
  - The capability of exporting the model to the Simulink
  - Fast model definition via dedicated GUI and TUI.



- To learn more:
  - QuickerSim https://emobility.quickersim.com/
  - Q-Bat product page https://www.mathworks.com/products/connections/product_detail/quickersim-q-bat.html

- For a free Q-Bat lite license, visit QuickerSim licensing website https://licensing.quickersim.com/

- To get **full version trial** write to q-bat@quickersim.com