



CASE STUDY /

## Ansys + KTM

“Regardless of model complexity and size, we can now solve computations of hour-long drive cycles in close to real time, while simpler models can take just minutes. The inclusion of a virtual battery pack also helped our team identify and eliminate potential problems in battery design, including design issues early on in the development process.”

**David Singer**

Simulation Engineer for Multiphysics / KTM R&D

# KTM Goes Wide Open on Thermal Management of its E-Ride Traction Battery Design with Help from Ansys

In the spirit of no-trace off-road adventure, KTM, a European motorcycle manufacturer, is focused on taking electrification to the trails with its E-Ride dirt bike. With support from Ansys' channel partner CADFEM, KTM leveraged Ansys Twin Builder and Ansys Mechanical to develop a simulation workflow and a full 3D model useful in the virtual design, validation, and verification of a traction battery with optimized thermal properties.

## / Challenges

KTM has a previous history in the solitary use of simulation. An added challenge for the team was creating an entire workflow around battery optimization that used various tools to simultaneously analyze thermal interactions as they relate to thermal hotspot avoidance, temperature distribution, and charging efficiency. KTM needed to be able to use their own code to generate the lookup tables, then used Ansys simulation to tune the parameters and scale up from cells to modules.

## / Ansys Products Used

- Ansys Twin Builder
- Ansys Mechanical

## / Engineering Solution

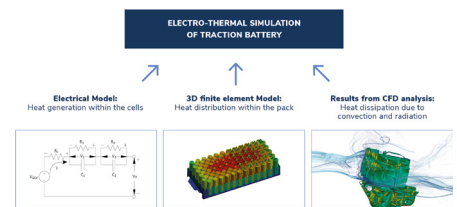
An electrical lumped model was used to predict the heat generation per cell as a function of each cell's temperature and its state of charge (SOC). Resulting values were then fed into a compact thermal model derived from 3D finite element method (FEM) models that calculate the battery's temperature distribution. A third submodule was then created based on computational fluid dynamics (CFD) analysis to calculate thermal dissipation of the battery housing resulting from convection and radiation. Mechanical was used to create and mesh the high-dimensional FEM model.

## / Benefits

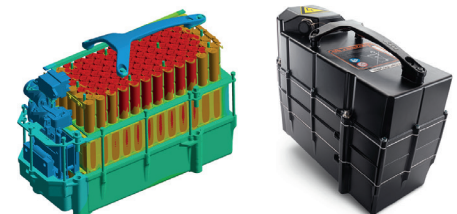
- The KTM team developed a simulation workflow enabled by Twin Builder consisting of three submodules coupled at the system level — all exchanging input and output data during computation.
- Twin Builder's Battery Wizard toolkit was used to generate automatic ECM lookup tables per cell of test data measured and recorded during pulse discharges at various temperatures. The cell ECMs could then be connected in parallel and in series to configure an accurate electrical battery module model.
- Parametric tuning for all circuit components enabled modeling of the instantaneous and dynamic behavior of the cell to better capture the heat generation and output voltage of the cell at different temperatures and states of charge.
- Once fully implemented in Twin Builder, the electro-thermal model of the battery pack could simulate real-world drive cycles and predict data outputs, including peak temperatures, temperature distribution, and heat transfer.
- System simulations revealed a 20-millivolt single-cell deviation of predicted output voltage and a predicted battery pack model temperature deviation of less than 2 °C, resulting in a stable battery pack design.

## / Company Description

KTM is Europe's leading high-performance street and off-road sport motorcycle manufacturer based in Mattighofen, Austria. Over the years, KTM has built a reputation as a fierce competitor on racetracks around the world. With an established presence in the off-road segments, KTM has progressed to become one of the world's most innovative manufacturers of street motorcycles, and now aims to be the world's biggest manufacturer of sport motorcycles.



Coupled complex electrical-thermal simulation



Simulated model (left) of real freeride e-battery pack (right)

**ANSYS, Inc.**  
[www.ansys.com](http://www.ansys.com)  
[ansysinfo@ansys.com](mailto:ansysinfo@ansys.com)  
 866.267.9724

© 2023 ANSYS, Inc. All Rights Reserved.