

Thermal simulation of rail vehicles

Development of the simulation software

ThermoTrainAnalyzer for thermal balances on a RhB train

Graduate



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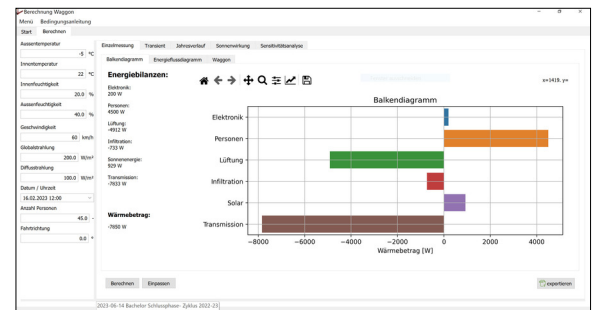
Problem: The Rhaetian Railway has been successfully transporting passengers and goods over the demanding rail network through the mountain valleys of the canton of Graubünden for 175 years. To ensure the well-being of the passengers in all weather conditions, the thermal control of the railway vehicle interiors is a major challenge. Until now, there have been no in-house thermal models for calculation, leaving the competence and design of heating and cooling systems to the suppliers. The aim of this work is to create an independent and user-friendly simulation program for the thermal processes in a railway wagon. This will be used to check offers from manufacturers and to forecast own estimations of thermal balances during summer and winter months.

Approach: In this study, the thermal influences on a rail vehicle were determined. With the help of a detailed literature search, the thermal influences were described by mathematical formulas. The individual heat amounts were balanced with Python. The first results were checked with a simple computer simulation. In order to gain further insights, a temperature measurement was carried out on a railway wagon. In addition, the heat inputs were virtually simulated using a 3D replica of the measuring vehicle with a simulation program. With this and with the help of detailed analyses, the significant parameters for the program could be identified. The intuitive usability of the software was generated with a graphical user interface.

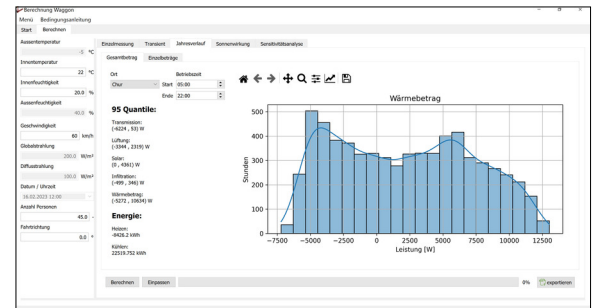
Result: With the program, it is now possible to generate railway wagon models of different variations. This allows analyses such as heating or cooling capacity at certain operating points, an annual simulation and parameter variations. Influences of adjustments to material and geometric properties can

be illustrated. In a further step, the reliability could be increased by determining unknown parameters with the help of a more detailed temperature measurement.

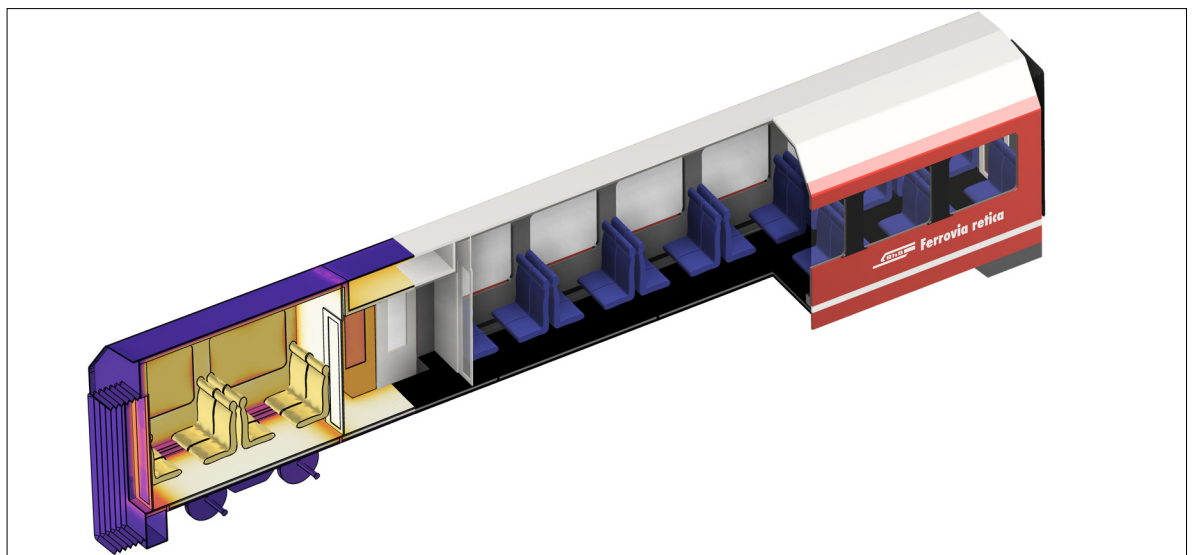
Graphical user interface for determining the cooling/heating capacity under static conditions Own presentation



Graphical user interface for an annual simulation of the thermal balances of a rail vehicle Own presentation



Railway wagon model and its thermal simulation Own presentation



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