

Contribution of the Simulation to the Optimization of the Thermal Management of Vehicles

Johann Betz, Thomas Anzenberger, Thomas Kobs

Abstract

Right from the early phase of development of vehicles simulation techniques are used to optimize the thermal management in variant driving cycles. The procedure presented in this article supports the design process and facilitates the discovery of optimums regarding

- Mechanical and electrical power consumption
- CO₂ emission and
- Climate comfort of the passenger compartment

Primary objectives of thermal management are

- The distribution of the energy flows within the vehicle to avoid friction losses in the engine and the power train and to minimize thermal masses within the system
- An efficient control of auxiliary devices, e.g. alternator and refrigerant compressor
- Appropriate control strategies for the passenger compartment
- The overcome of goal conflicts between fuel consumption and climate comfort

In the past these very complex and extensive topics have only been partly supported by single conventional simulation tools. Mostly the specific information of numerous approved tools and a lot of communication was needed to handle a single question from above. Various acquisition and administration efforts were necessary to integrate the punctual knowledge of these single simulation models.

Practical applications point out that „Network based” simulation is a new and efficient method for the development of thermal management systems of future passenger cars. The overall simulation contains various sub-modules which describe the gearbox, power train, passenger compartment, air conditioning, engine, supercharging devices, alternator, cooling circuit, cooling air flow, electric devices, and controller units. Each of these modules is established and provided from experts in their specific fields. A predefined interface, containing the input and output parameters of the single modules, enables an automatically supported connection between the modules when building up the entire mockup. A special software platform is connecting all the single software modules and performs the parameter exchange, the time step control, the numerical stability and the post-processing.

Based on an up to date application the advantages of the presented approach are shown. Various simulation runs for different driving cycles have been accomplished to find out an optimum configuration for the thermal management system of the vehicle. The simulation results presented here are verified extensively with real world vehicle measurements.

Authors

Dr.-Ing. Johann Betz

AUDI AG, I/EK-41, 85045 Ingolstadt
Tel. +49 841 81628
johann.betz@audi.de

Dipl.-Ing. Thomas Anzenberger

AUDI AG, I/EK-41, 85045 Ingolstadt
Tel. +49 841 92728
thomas.anzenberger@audi.de

Dipl.-Ing. Thomas Kobs

AUDI AG, I/EG-341, 85045 Ingolstadt
Tel. +49 841 30460
thomas.kobs@audi.de