Reduction of an unsteady and non-linear cabin thermal model for automotive energy optimisation

Youssef HAMMADI
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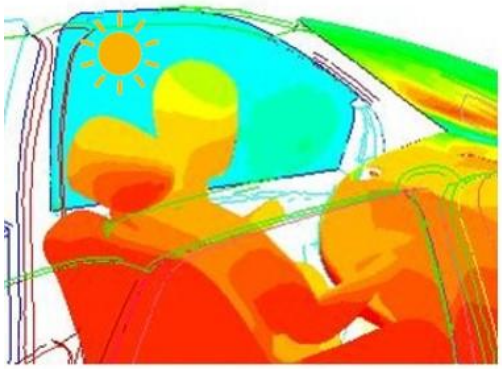
Industrial Partner: Renault Group
Supervisors: D. Ryckelynck and A. El-Bakkali



- Defining a reduction methodology for 0D models based on Bond Graph approach
- Reduction of non-linear Differential Algebraic Equation systems
- Building Reduced Order Models for cabin transient thermal analysis
- Methodology integration into the cabin thermal simulation chain

Abstract:

The use of air conditioning in cars leads naturally to an over-consumption of fuel. Over one year in France for example, this overconsumption varies from 1 to 7% according to the Environment and Energy Management Agency [1].
For this reason, several projects within Renault Group aimed to reduce the consumption of the air conditioning system. It's the case of the project [THERM], whose objective is to cut by 25% the air conditioning average consumption for combustion-powered vehicles. One of the four axes of this project concerns the choice of materials. Thus, all thermal losses through vehicle cabin walls were computed using a 0D in-house model developed under AMESim. This helps to reduce the losses through the most affected walls by using either insulating technologies, to reduce conduction losses, or new innovative glasses, to limit the effect of solar radiation.
Currently, the [NUMERICAL VEHICLE] project aims to develop an energy synthesis platform to help decision-making as soon as possible in new vehicles development process. In this context, the purpose of the current PhD topic is to develop reduction methods for 0D models and to integrate them into the cabin thermal simulation chain, in order to accelerate optimization cycles (compromise between thermal comfort and air conditioning overconsumption).
[1] L. GAGNEPAIN (2006). La climatisation automobile, Impacts consommation et pollution. ADEME – Département Technologies des Transports.