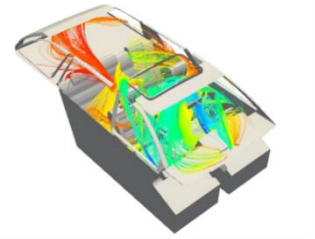
Reference sheet/Success story

Thermal management

Thermal comfort in an automobile passenger compartment

Objective

The automotive sector is a highly competitive sector, which forces manufacturers to offer ever more innovative models. As a result, customers in the sector are always expecting new standards for their vehicle. Thermal comfort in the passenger compartment is one of them, a performance which is associated with an improved sophistication of the vehicle. However, the effectiveness of this system depends, among other things, on the dimensions of the passenger compartment, the materials, the number of passengers, the external conditions, etc. For these reasons, thermal regulation is complex, thus presenting the opportunity to treat it in an innovative way on each car model. In this context, Zelin conducted several analyzes on vehicle ventilation, with as objective, the control of the system reliability irrespective of the external conditions (rain, frost, etc.), while ensuring optimal thermal comfort for the passengers.



Result

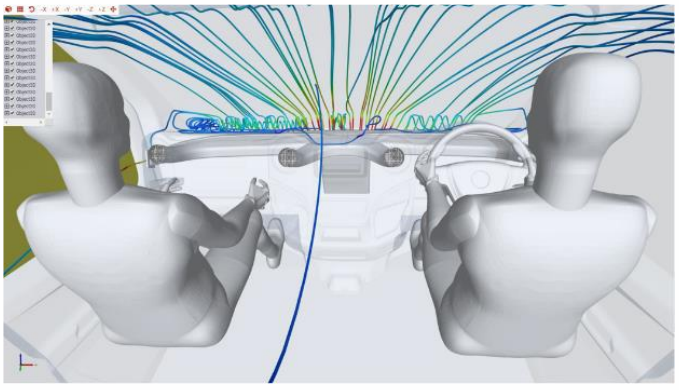
The aerothermal analysis of the passenger compartment made it possible to observe the temperature distribution and to estimate the time necessary to establish thermal equilibrium. In addition, an accurate analysis of the humidity in the passenger compartment, one of the key parameters for passenger comfort, as well as the window fogging analysis, could be provided to the customer. An optimization of the ventilation system has been carried out in order to guarantee optimal passenger comfort. Finally, suggestions for improvements to the ventilation system were proposed to the client to ensure effective window defogging irrespective of the weather conditions.

We can also point out that in another context, the thermal comfort in the aeronautical field, we have implemented a methodology which made it possible to design a complete system without having to resort to physical prototyping beforehand. This fully digital design was praised by the client and allowed them to save precious time on their product development cycle by drastically reducing it.

Implementation

Zelin has implemented an original digital method for modeling this type of flow:

- 3D model of the passenger compartment
- Material resources: HPC cluster (200 cores)
- Use of OpenFOAM, ANSYS Fluent and Star CCM + codes
- Some analytic examples:
    - Advanced mesh sensitivity (up to 3 million cells)
    - Unsteady approaches (URANS)
    - Modeling of heat exchange
    - Thermal and hygrometric modeling of passengers
    - Study of passenger thermal comfort conditions
    - Determination of a window fogging criterion



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