# Renault applies AMESim to streamline its cooling and air-conditioning systems development process

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The market-oriented massive reduction of development costs and delays, coupled with the multiplication of in-car intelligent systems and their respective interactions lead to a major reorganization of the design processes. To ensure optimal performance, quality and passenger comfort, design teams have to handle lots of scenarios simultaneously. Since the use of physical prototypes and associated testing significantly increases delays and budgets, assessing multiple design scenarios can only be done with the help of numerical simulation. The engineering of the underhood thermal environment of a vehicle faces the same challenges. The performance of the engine cooling, air conditioning and turbocharged air systems through their respective heat exchangers are directly driven by the cooling air flow. This in turn is greatly influenced by the front design of the vehicle. For each new car development program, Renault engineers used to spend a lot of time on the integration of cooling and air-conditioning devices to fit given vehicle designs, with regards to assembly/disassembly, maintenance, efficiency, etc. For every new car design, several physical mock-ups were created. Then, through several days of wind tunnel testing, the design of the air entry together with layout of the heat exchangers was defined and optimized.

## Thermal management of underhood systems

To comply with the multiple constraints relative to vehicle designs that affect the thermal management of underhood systems, and to ensure high-quality passenger comfort, Renault decided to rely more on simulation to engineer the underhood thermal environment. The French car maker deployed the AMESim solution as a collaborative system simulation platform. IMAGINE supported Renault with technical benchmarks, deployment support for AMESim and project assistance.

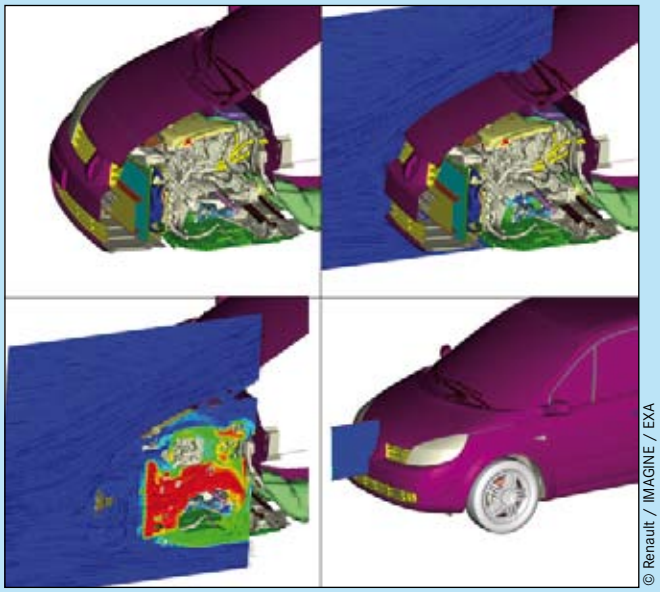
The AMESim solution was successfully applied in thermo-fluid combined simulations, including the simulation of refrigerant systems (using the Two-Phase Flow and Air Conditioning libraries), cooling systems (using theThermal Hydraulic et Cooling System libraries) and air systems (using the Thermal Pneumatic library). The AMESim Thermal Management solutions provide the aeraulic dimension which is essential for underhood thermal management, thanks to the new dedicated heat exchanger stack HEAT toolset (Heat Exchanger Assembly Tool).

Using the AMESim simulation platform, Renault engineers can easily assess multiple scenarios, which integrate various air entry geometries coupled with different working modes such as fan operation, air conditioning on/off switching, several turbocharging levels, etc. This approach reduces the number of physical prototype tests and wind tunnel sessions later in the development process.

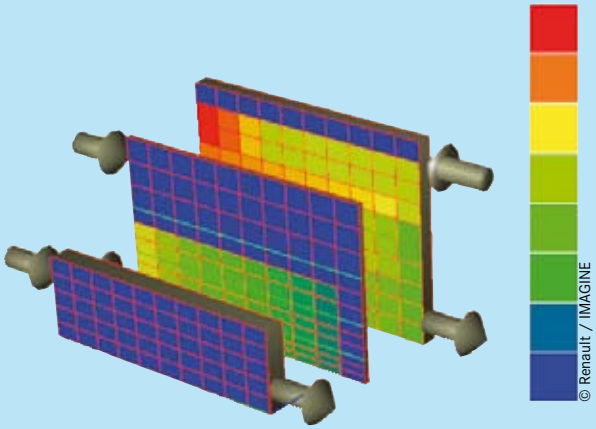
Furthermore, the validation of this numerical approach, formerly done on a production vehicle by comparing the results with data collected from a wide testing campaign, revealed the relevance of a strong and seamless coupling between AMESim and the CFD code PowerFlow from EXA. The coupling of both tools was particularly valuable for the modeling of thermofluid systems and underhood aerodynamics linked to the heat exchangers.

## Reducing prototype testing

The AMESim simulation methods enabled Renault to define the best passenger comfort scenario, to optimize the engine air intake in terms of its performance control and the emissions resulting from the engine cooling strategies (EuroV and VI standards). Renault engineers particularly appreciated the flexibility of the AMESim platform and the quality of the obtained results. Therefore, the use of AMESim has been extended to the development of a wider set of Renault's vehicles.




AMESim-CFD code coupled results on Scenic II




HEAT 3D Temperature Representation

Overall, the use of AMESim solutions triggered a revolution in Renault's air-conditioning and cooling system development process: while high quality standards where maintained, the number of physical tests was reduced with more than 50%. Thanks to AMESim, more design alternatives can be explored, which enables engineers to more accurately size the global project and drive corrective actions faster and more precisely. Renault switched from a costly process that entirely relied on physical testing to a simulation driven process with high-quality output, strong flexibility, and the capacity to postpone physical testing to the final validation stage.

"The use of AMESim opens the doors to a massive reduction of costly physical mockups and associated tests while improving engine performance and emissions, and vehicle quality and comfort. With AMESim, we have reduced the number of physical prototypes by more than 50%."

**Sébastien BREMONT, Renault**

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