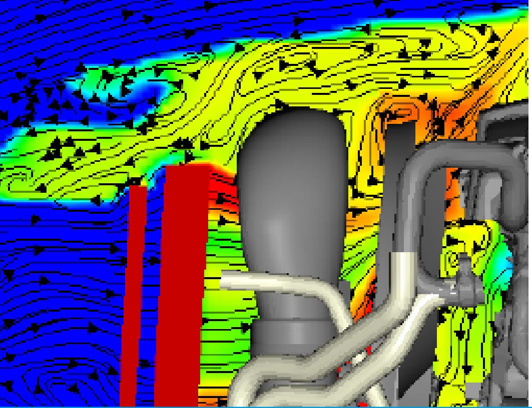
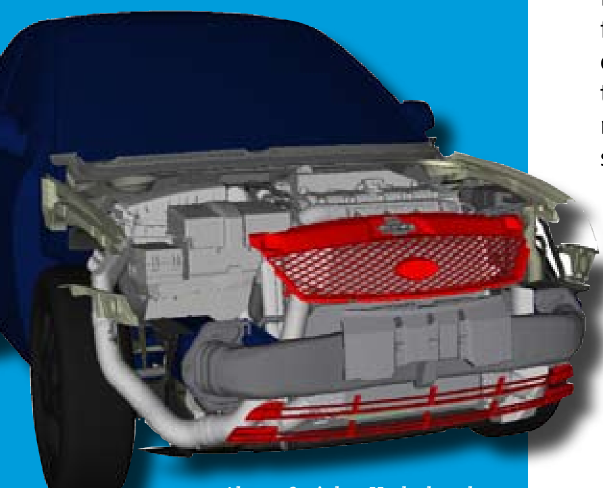


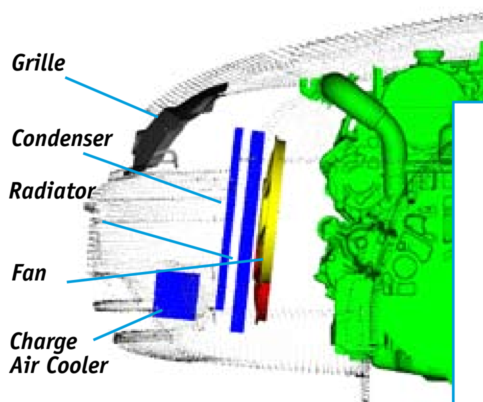
PowerCOOL™

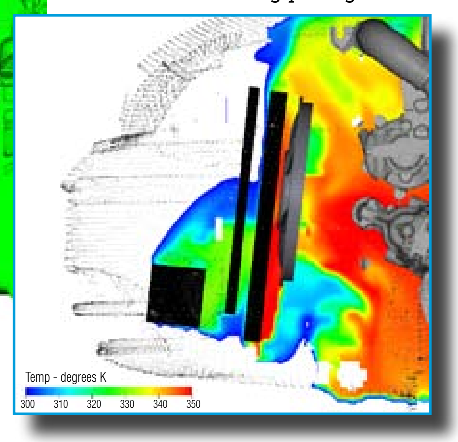
ABOUT POWERCOOL

PowerCOOL provides the capability to predict the heat transfer exchanged between air flow calculated by Exa's PowerFLOW, and the heat exchangers. The result is provided either as the temperature of the coolant at the inlet into the heat exchanger (top tank temperature) or the heat rejection. In addition to these values, PowerCOOOL can measure distribution of air parameters like velocity, temperature, and density on the surface of the heat exchanger as well as heat exchanger coolant temperature distribution. These parameters provide essential information needed for the positioning of the heat exchangers, their operation and the overall underhood design.



Above & right: Underhood simulation of Ford Mondeo with PowerCOOL results



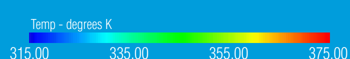


Simulation of Ford Mondeo underhood and cooling package

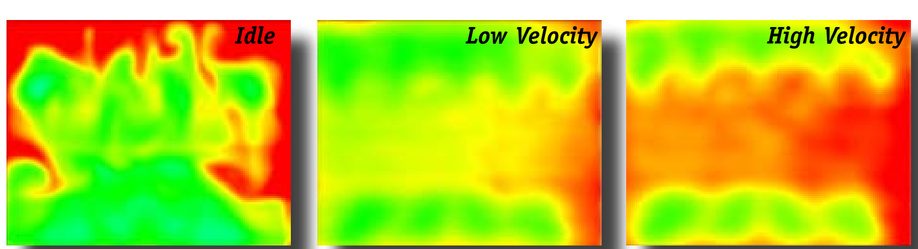
Low Velocity	-2.3°C
High Velocity	-1.1°C

Difference between the top tank temperature measurements and PowerCOOL predictions for the radiators

Below & right: The calculated air temperature fields behind the radiator for the Land Rover LR3



Air flow in the underhood area is the primary source of engine cooling. A quick look at the vehicle underhood reveals exceptionally complex geometry. In addition to the engine, there are fans, radiators, condensers, other heat exchangers and components. The air flow needs to have adequate access to all relevant parts that require cooling. Due to the complex geometry, the task to ensure sufficient air cooling is not a simple one. The air flow entering from the front grille is affected by many components on its path through the underhood. Even small geometry details affect the flow direction and can easily cause recirculation regions which reduce the cooling efficiency. Therefore, air cooling flow analysis requires detailed treatment of the underhood geometry and at the same time accurate air flow modeling.



POWERCOOL SPECIFICATIONS

Main model characteristics

- Heat exchanger is modeled as a porous media
- Heat transfer between the internal and external flow based on measured heat transfer coefficients
- Measured data is scaled based on temperature difference in experiment and simulation

Types of supported heat exchangers

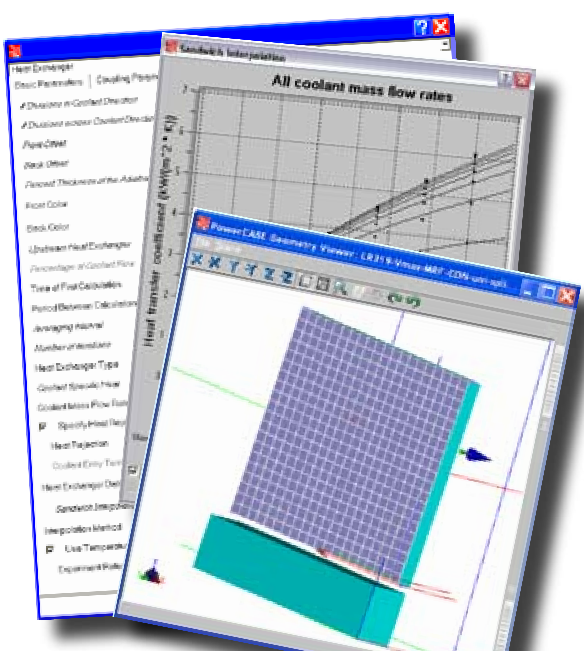
- Models available for radiators and charge-air-coolers
- Currently supporting I- and U-type radiators
- Radiators can be connected in series

Input parameters

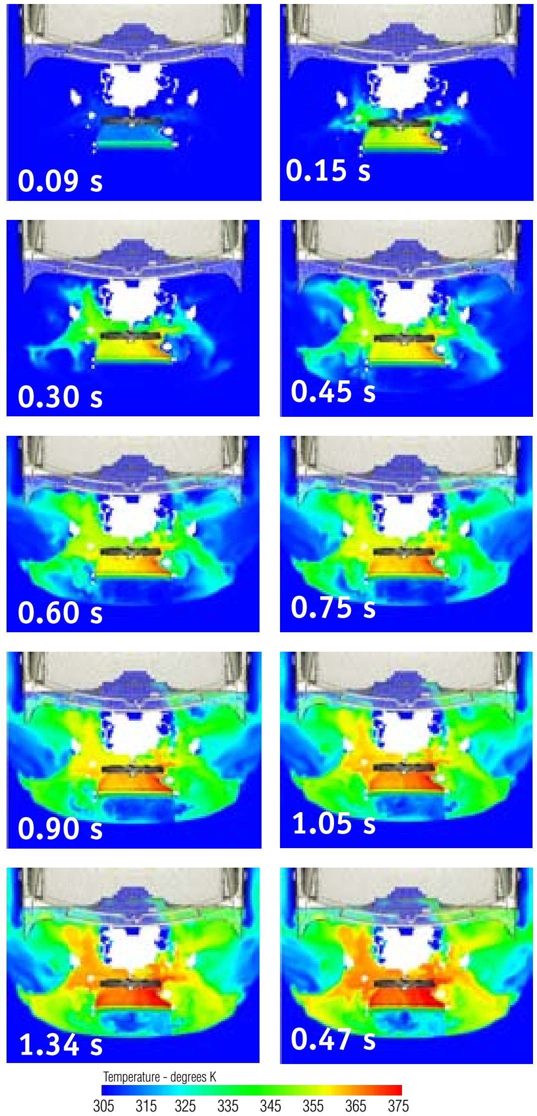
- Heat exchanger geometry
- Measurements for thermal characteristics
- Measurements for pressure drop as a function of air flow rate
- Internal mass flow rate
- Inlet coolant temperature or heat rejection

Fully integrated with PowerFLOW

- The set-up process is seamlessly integrated within PowerCASE
- PowerCOOL is being run in the background by a PowerFLOW simulation
- Airflow is calculated by PowerFLOW
- Coolant flow calculated by PowerCOOL
- No need for user intervention during the simulation



PowerCOOL User Interface



Evolution of the temperature field as a function of time for the Land Rover LR3.

POWERCOOL SPECIFICATIONS CONT.

Can run as a standalone application

- PowerCOOL can be run from the command line.
- Takes only a few seconds to run allowing investigation of the influence of input parameters on the heat exchanger performance.

Output files

- Can be visualized in Exa's PowerVIZ

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