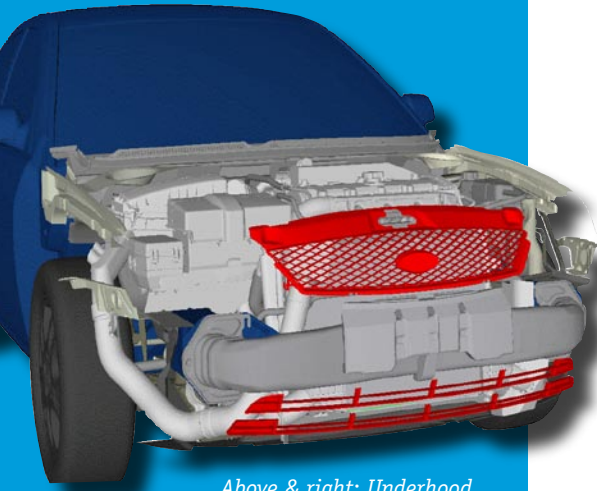


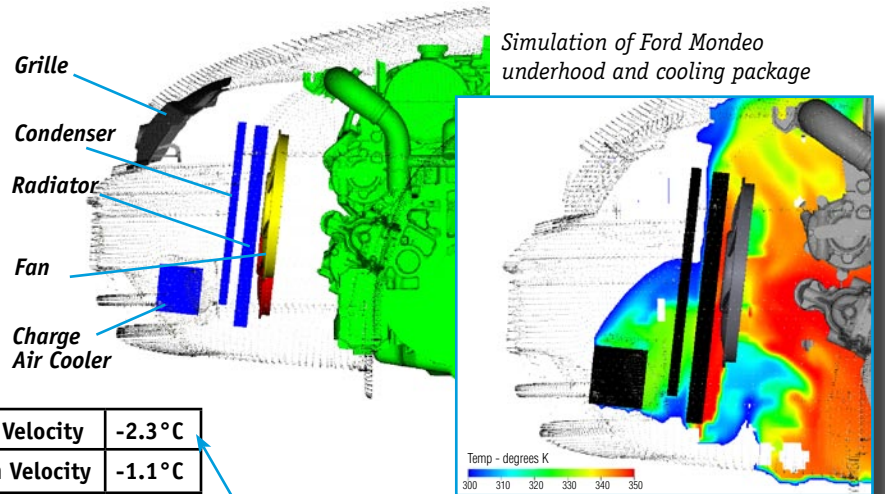
PowerCOOL

MEASURING HEAT EXCHANGERS & COOLING AIRFLOW

PowerCOOL® is used to model heat exchangers such as automotive radiators or charge air coolers. It is invoked by a PowerFLOW simulation in a coupled mode to predict the heat exchanged between the air flow, calculated by PowerFLOW, and a heat exchanger. The result is provided either as the temperature of the coolant at the inlet of the heat exchanger (top tank temperature) or the heat rejection. Users choose between these two options based on design goals and available data. Other results include distribution of air parameters like velocity, temperature, and density on the surface of the heat exchanger, and coolant temperature distribution within the heat exchanger. These results provide essential information needed for positioning heat exchangers, understanding their operation and optimizing the overall underhood design of a vehicle.



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

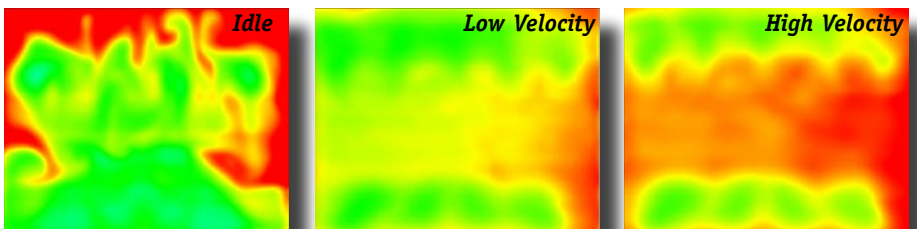


Difference between the top tank temperature measurements and PowerCOOL predictions for the radiators

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

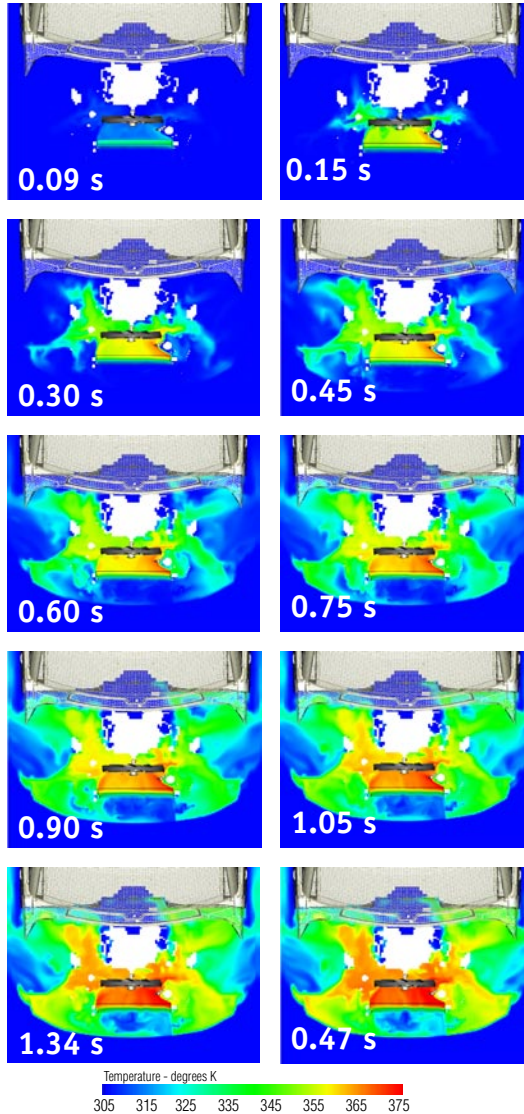
- Models available for radiators and charge-air-coolers
- Currently supporting I- and U-type radiators
- Radiators can be connected in series

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



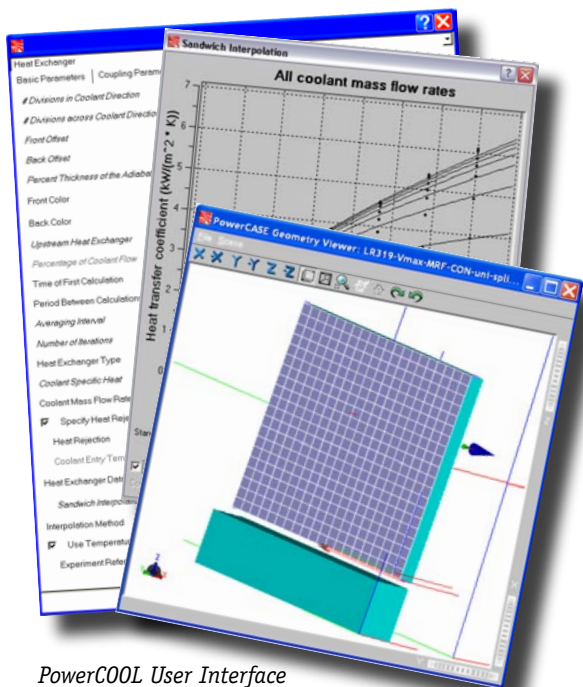
Evolution of the temperature field as a function of time for the Land Rover LR3.

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



PowerCOOL User Interface

CONTACT INFO

Corporate Headquarters:

Exa Corporation
55 Network Drive
Burlington, MA 01803
U.S.A.

1 781/564-0200
1 781/564-0299 - FAX
www.exa.com
info@exa.com

Exa has offices in: France,
United Kingdom, Germany,
United States, Japan and
Korea with distributors in
China and India.

To find an Exa office or
distributor near you,
please visit our website.