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Simcenter STAR-CCM+ external vehicle aerodynamics

Accelerate aerodynamics innovation with fast and accurate CFD simulations

Benefits

- Accelerate aerodynamics innovation with fast and accurate CFD simulations
- Quickly prepare complex geometries with thousands of parts using surface wrapping and automated meshing
- Increase throughput with fast and accurate steady-state simulations
- Run high-fidelity, transient simulations including rotating rims
- Get detailed design insight based on surface sensitivities for drag
- Save engineering time by automating automotive aerodynamics

Summary

Today there is a strong need for fast and accurate external aerodynamics simulations. The range of an electric vehicle is a key decision parameter for potential customers and optimizing/minimizing aerodynamic drag to increase the range is a crucial engineering target. In addition, new emissions regulations require reporting fuel consumption of individual vehicle configurations, which can be in the thousands. Therefore, simulations must be able to accurately predict the difference in drag values (deltas) between designs as it is now mandatory for development and official reporting. Otherwise, original equipment manufacturers (OEMs) need to carry out expensive and time-consuming wind tunnel measurements. To enable these simulations, users must be able to:

- Reduce geometry preparation time and mesh thousands of complex parts easily and quickly
- Run hundreds if not thousands of simulations with consistent and highly accurate results
- Leverage high-fidelity simulation approaches to ensure confidence in results
- Reduce setup time and automate the simulation workflow

Slimcenter STAR-CCM+ offers the solution

Simcenter™ STAR-CCM+™ software, which is a part of the Xcelerator™ portfolio, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software, is a multiphysics computational fluid dynamics (CFD) simulation software that allows users to build a high-fidelity, comprehensive digital twin of real-world products. It uniquely integrates every step of the simulation process, from geometry definition to meshing, solution and postprocessing and enables you to quickly assess the impact of configuration or design changes on aerodynamic performance before building a physical prototype. Simcenter STAR-CCM+ provides:

- Fast complex geometry handling, reducing preparation time from weeks to hours with surface wrapping
- Accurate physics, getting consistent and accurate results using steady and unsteady solvers combined with state-of-the art turbulence modeling
- Speed and performance, accelerating throughput with parallel volume meshing and excellent solver scalability
- Design exploration, getting detailed insight into surface sensitivities using adjoint solver
- Process automation, reducing setup time using templates, a dedicated vehicle aerodynamics workflow or macros

Simcenter STAR-CCM+ external vehicle aerodynamics

Geometry preparation and meshing

Dramatically reduce preprocessing time using a fully automated meshing pipeline:

- Surface wrapping is a robust and fast surface preparation approach that converts complex input geometries into a clean watertight surface
- The trimmed cell mesher offers great scalability even on high core counts and low memory consumption. Therefore, it is the first choice for external aerodynamics simulations
- The prism layer mesher is easy to use and robust to generate low y+ meshes on exterior surfaces

Accuracy

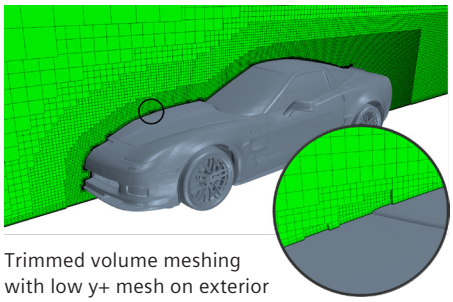
Achieve highly accurate, consistent and reliable simulation results using several key capabilities:

- Low y+ meshes on crucial surfaces accurately capture boundary layer phenomena and enable the prediction of flow separation
- State-of-the-art turbulence modeling for steady-state Reynolds-Averaged Navier-Stokes (RANS) and unsteady detached eddy simulation (DES) simulations
- Moving mesh approach for real-world simulation of rotating rims
- Capability to create a validated digital wind tunnel for your development work

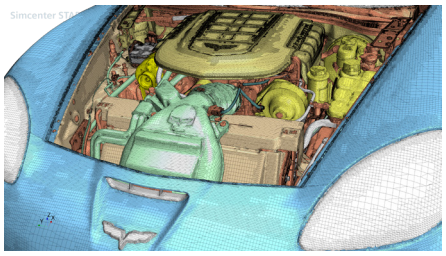
Advanced modeling approaches

Get deeper insight with advanced modeling approaches:

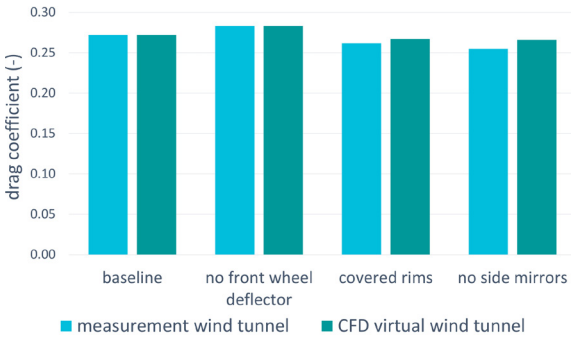
- Obtain unique insights for potential design improvements with surface sensitivities with respect to drag calculated by the adjoint solver
- Perform surface morphing operations based on the adjoint solution to improve your design
- Execute fluid-structure-interaction (FSI) simulations to calculate the deformation of components due to pressure loads
- Investigate water management aspects by using a wide range of validated multiphase models
- Analyze aeroacoustics phenomena such as side mirror noise



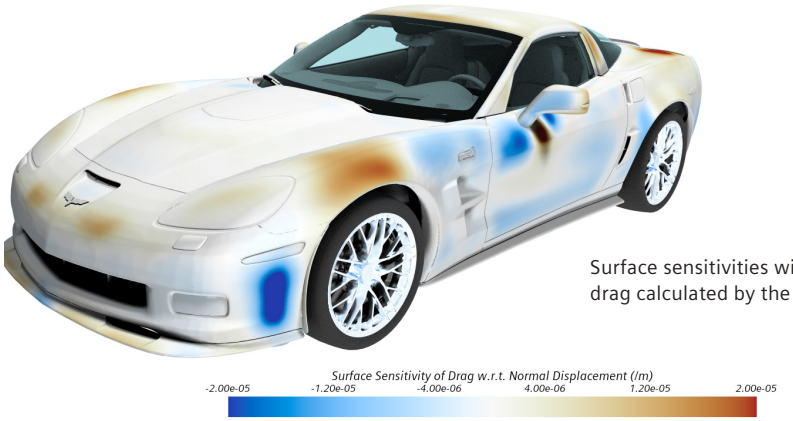
Trimmed volume meshing with low y+ mesh on exterior surfaces.



Complex geometry meshing, industrial automotive underhood.



Validated digital wind tunnel results for production car aerodynamics (credit: Emil Ljungskog, doctoral thesis, "Evaluation and modeling of the flow in a slotted wall wind tunnel", 2019).



Surface sensitivities with respect to drag calculated by the adjoint solver.

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