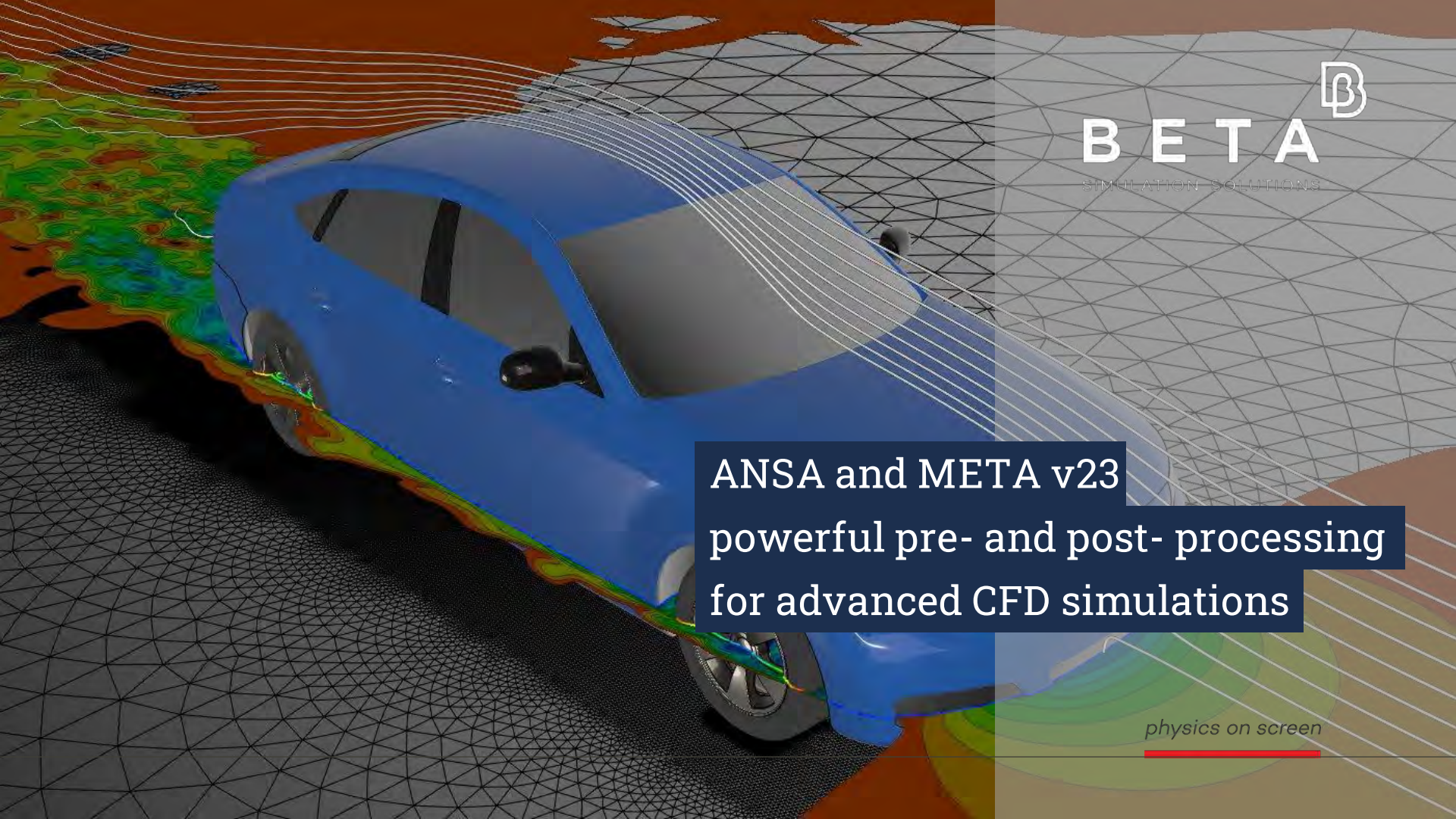

BETA
SIMULATION SOLUTIONS
ANSA and META v23
powerful pre- and post- processing
for advanced CFD simulations
physics on screen

By permission of Wirth Research Ltd

ANSA specifications for CFD:

Supported platforms:
- Linux
- Windows

- ✓Parallel processing on multi core hardware for maximum speed
- ✓64 bit code for unlimited memory usage
- ✓Double precision for high accuracy

Input/Output:

CFD formats:
Fluent (standard and HDF5)
Star-CD/CCM+
OpenFOAM
CFD++
CFX5
SC/Tetra
CGNS
TAU
SU2
FUN3D
RavenCFD
CobaltCFD
Kestrel AVMesh
PLOT3D
CMSoft AERO-F
UH-3D

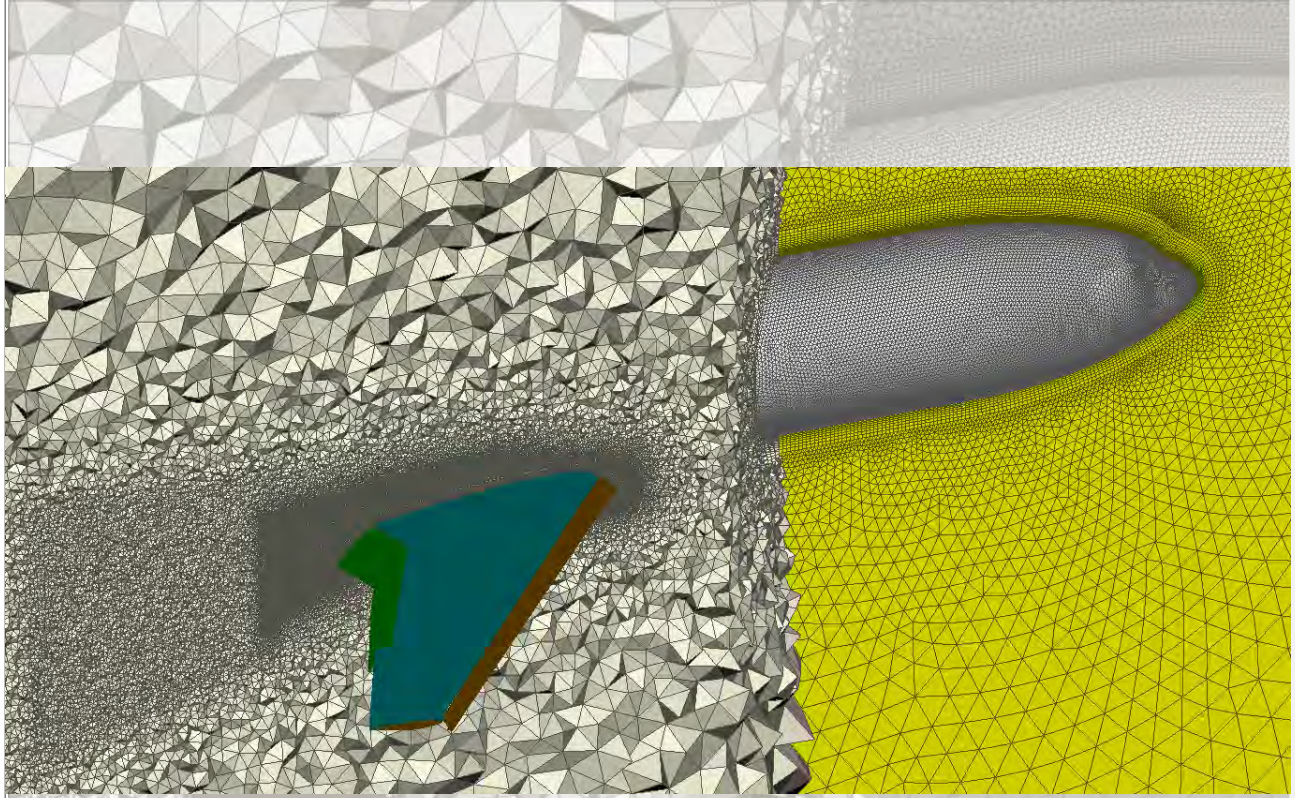
Other formats:
PATRAN
STL
VRML
and more..

Direct Interfaces with other CAE codes:
TAITherm
THESEUS-FE
NASTRAN
ABAQUS
ANSYS
LS-DYNA
and more..

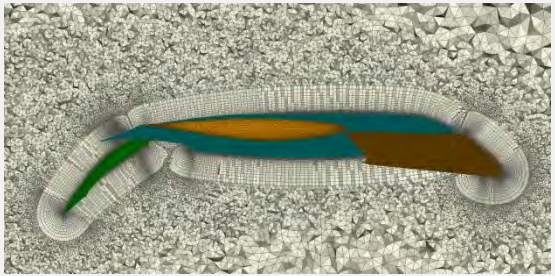
CAD formats:
CATIA v4, v5, v6
Unigraphics NX
PTC Creo Parametric
JT
SolidWorks
Inventor
Parasolid
Rhinoceros
IGES
STEP
IFC

Industrial scale pre-processing

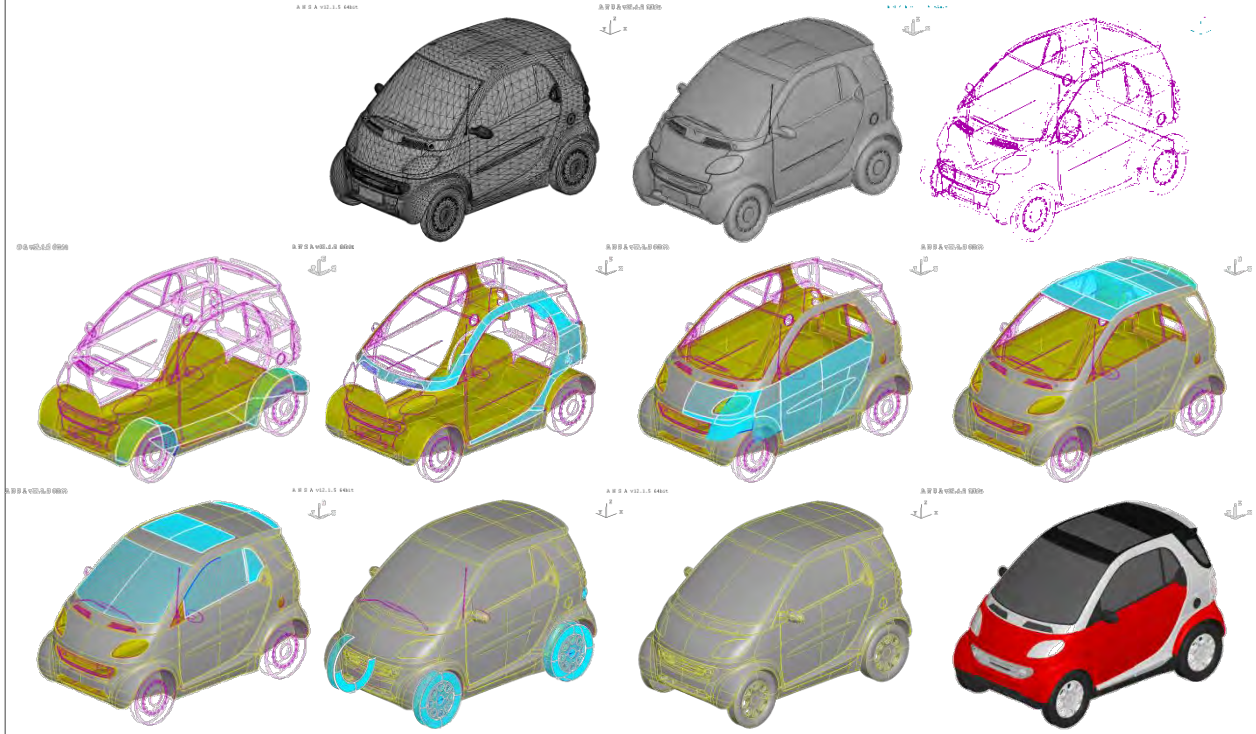
Powerful generation and visualization of large CFD models



GMGW-2 CRM model
287 million cells



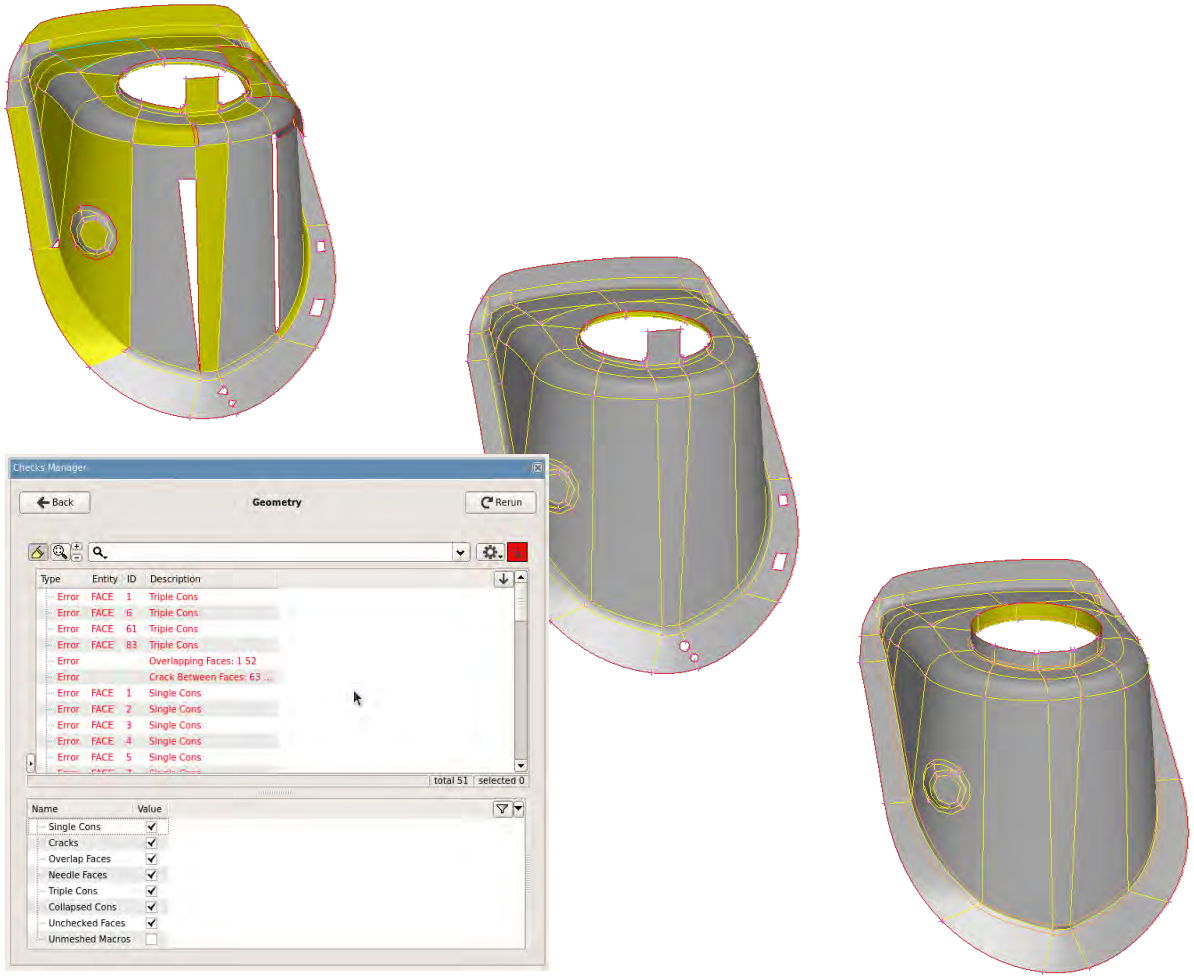
Geometry handling

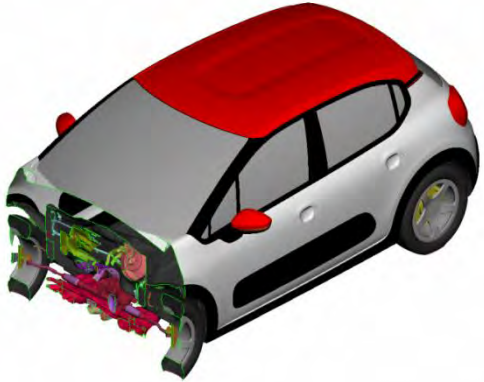


Geometry Handling

"CAD feel", easy-to-use functions for creation and manipulation of geometrical entities (points, curves, surfaces)

Advanced automatic and manual clean up tools

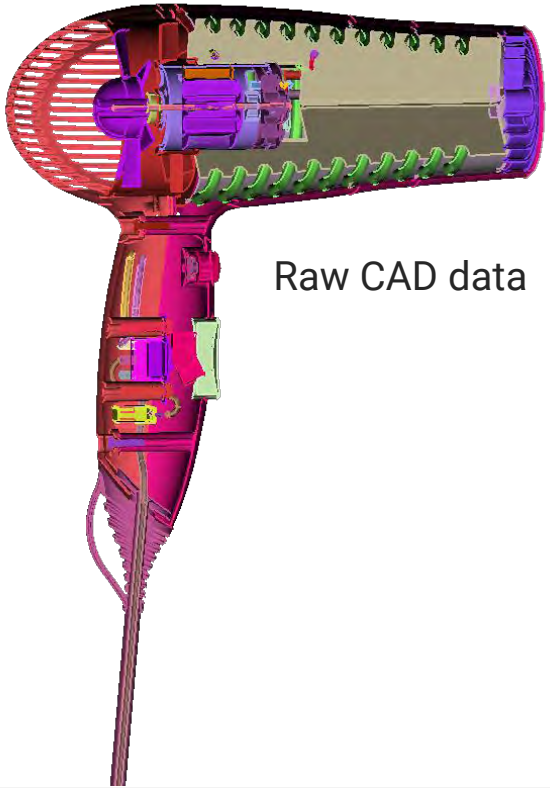




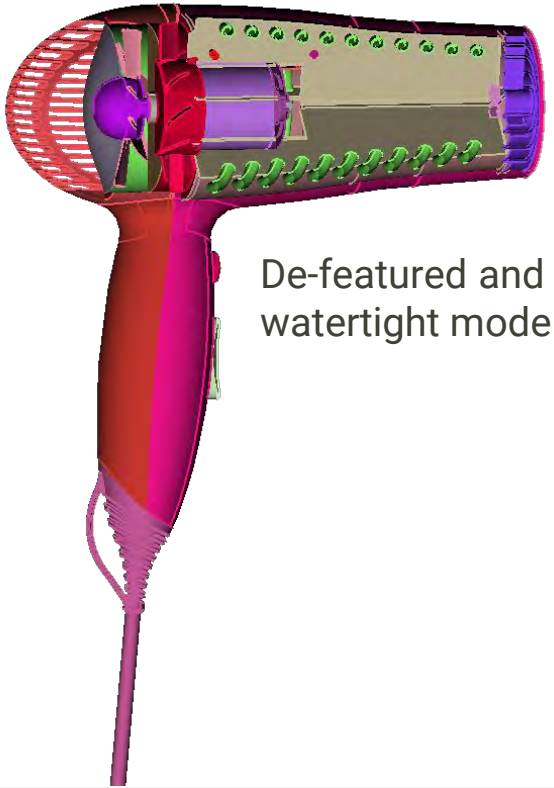
Courtesy of PSA

Cutting planes for model examination and cross section creation

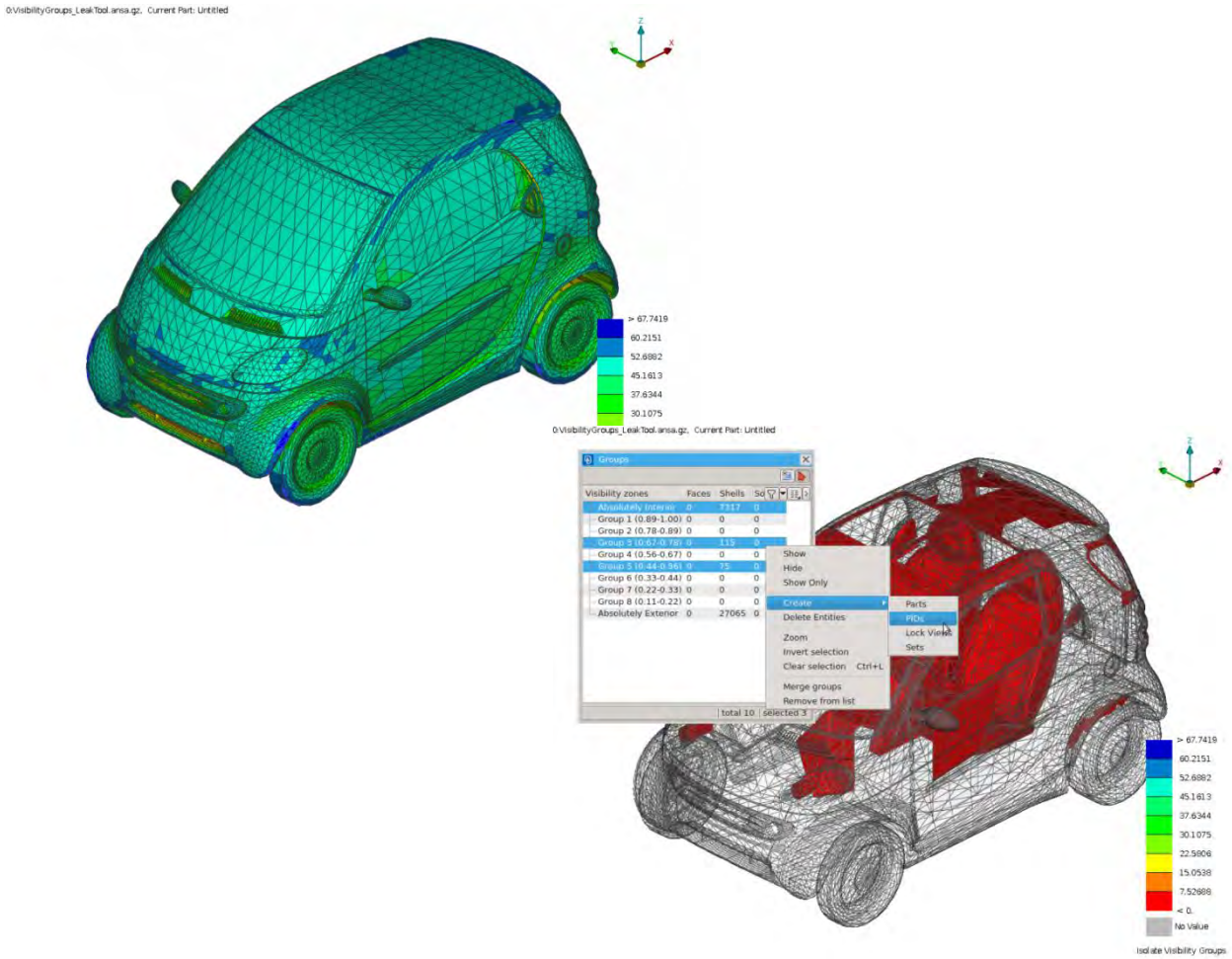
De-featuring and watertight model preparation



Raw CAD data



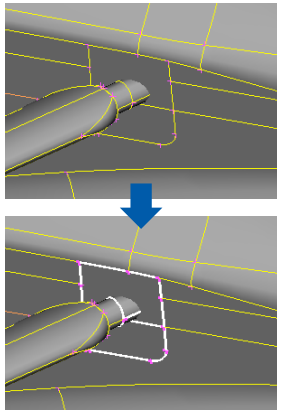
De-featured and watertight model



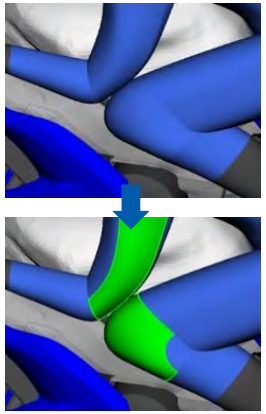
Powerful algorithm to automatically isolate interior or exterior surfaces

De-featuring and watertight model preparation

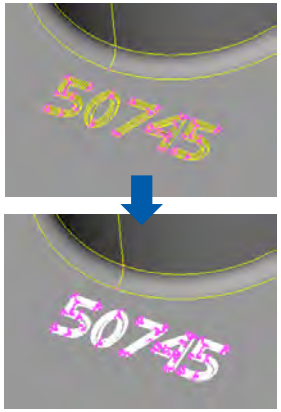
Intersections



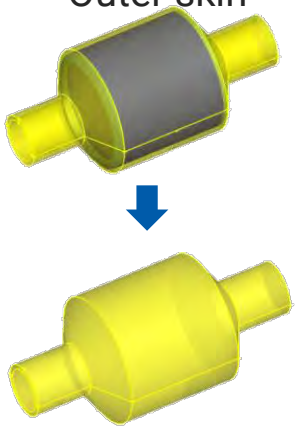
Contacts/Proximities



Emboss logos

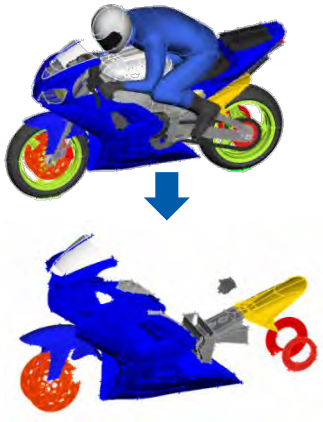


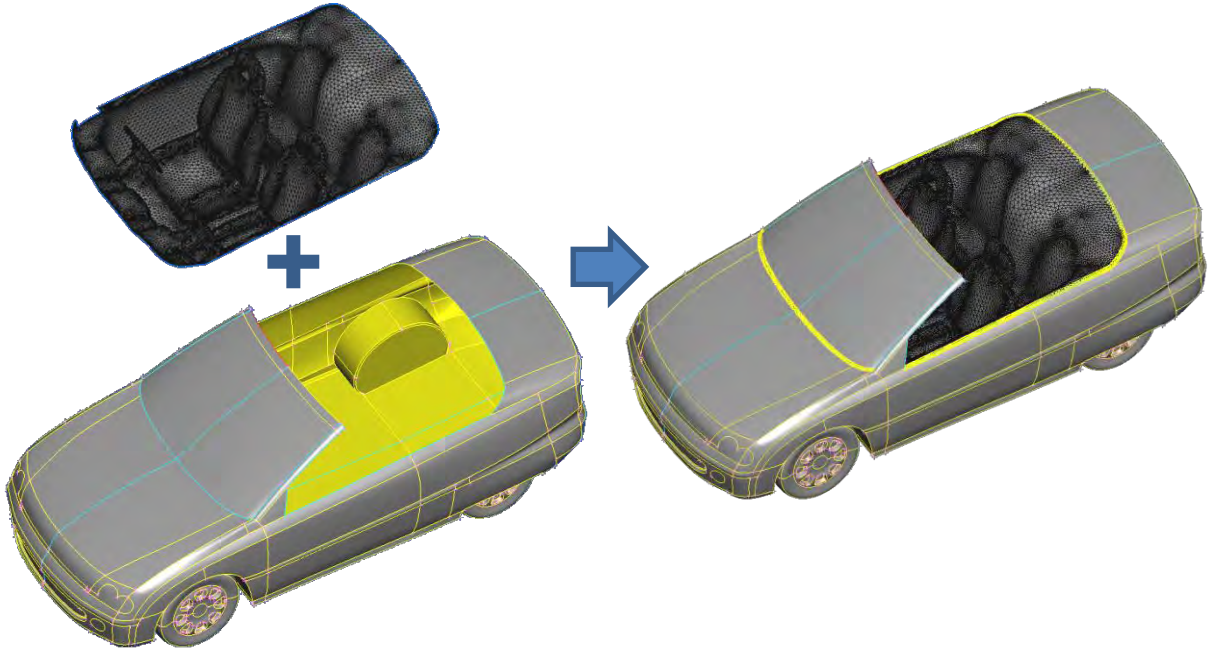
Outer skin



Inner passages

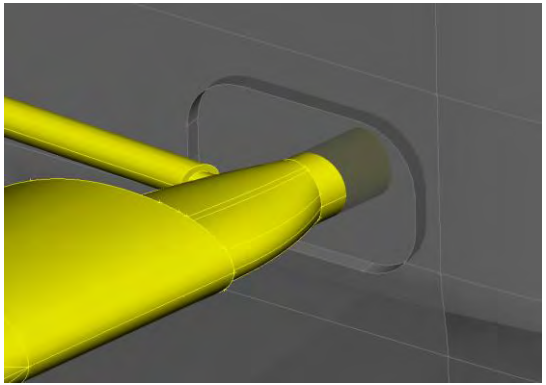
Baffles

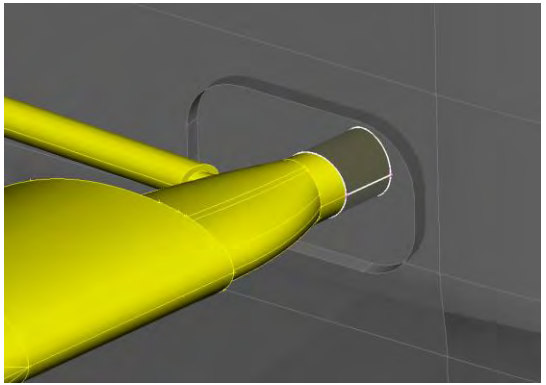


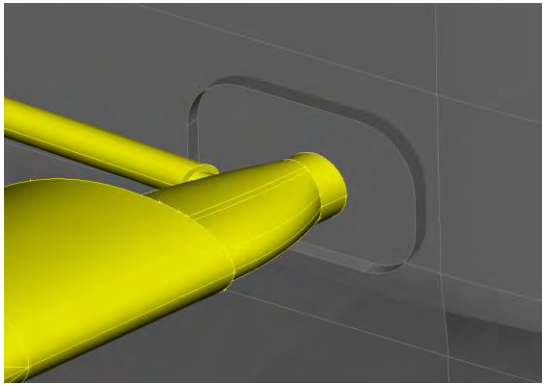


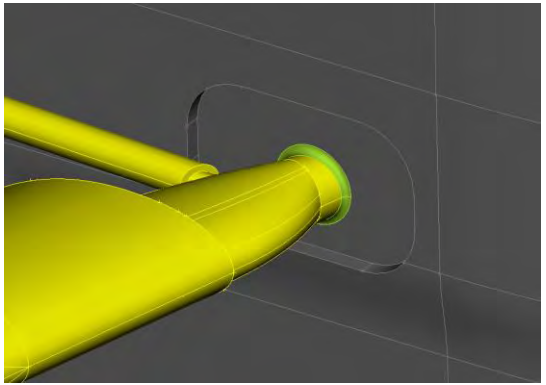
Combining Geometry and FE-model mesh (non-geometry mesh)

Powerful tools for management and connection of CAD geometry and existing FE-mesh

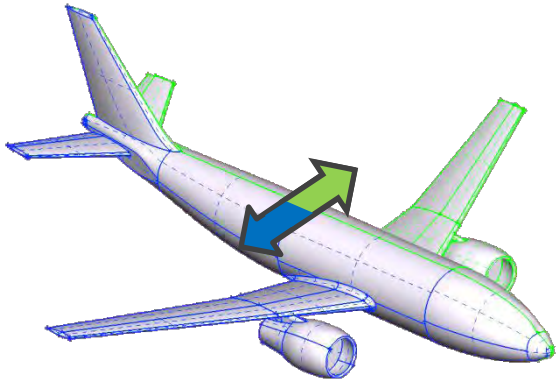


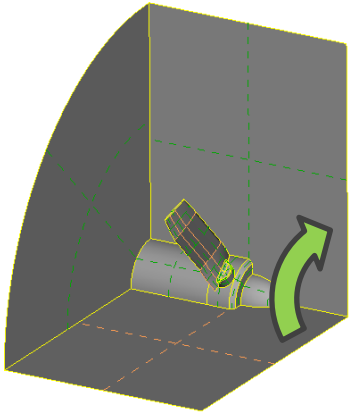


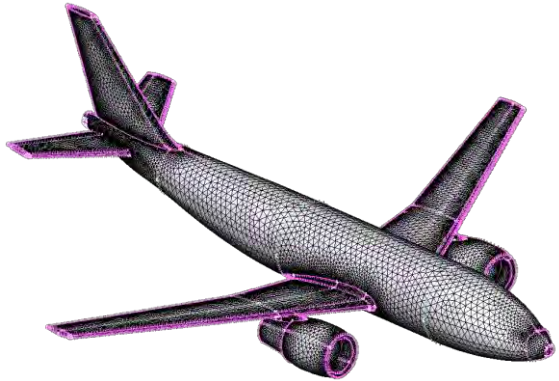


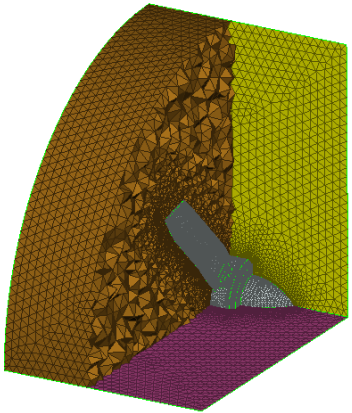


Boolean operations on geometry with option for fillet creation



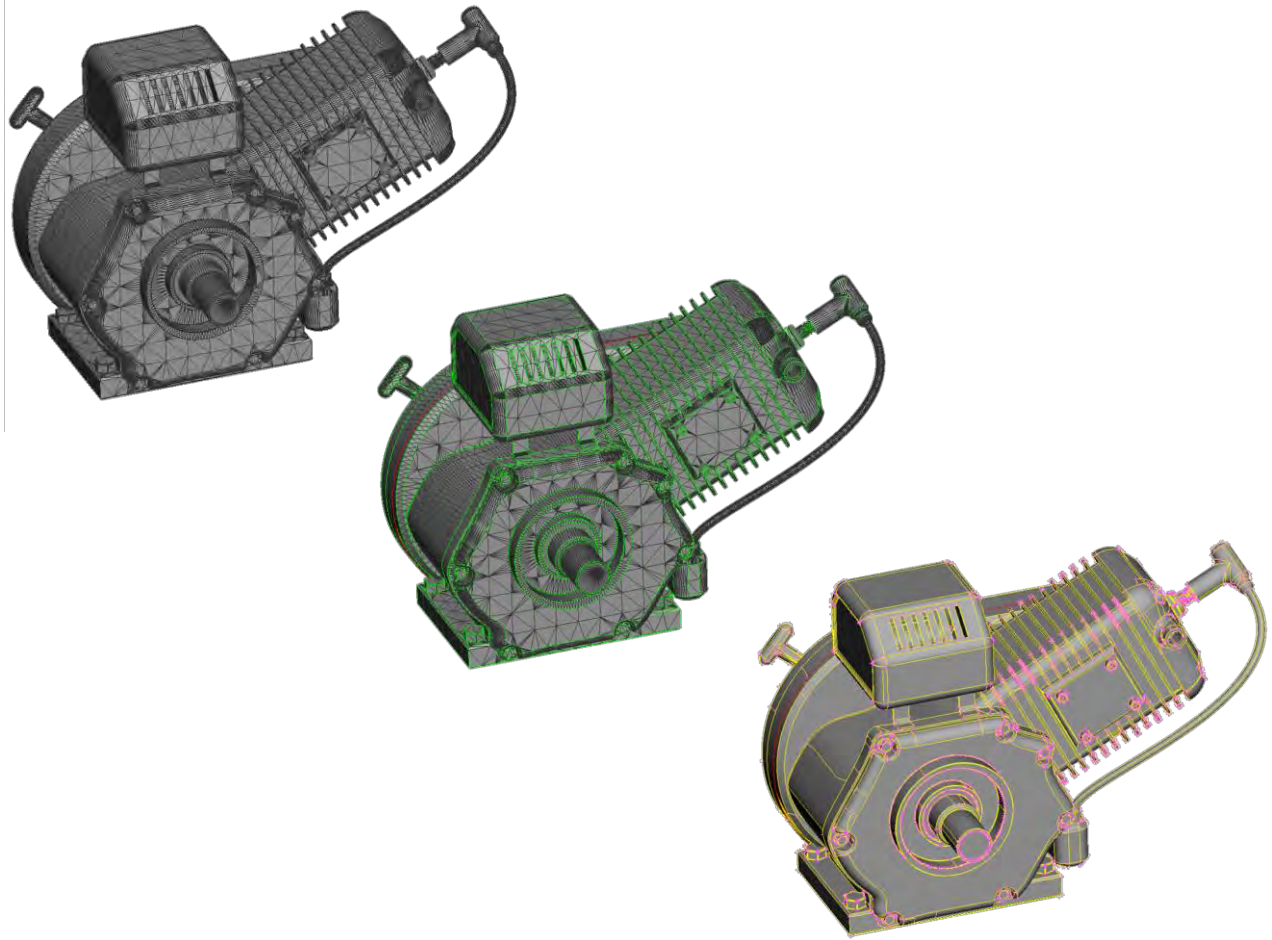






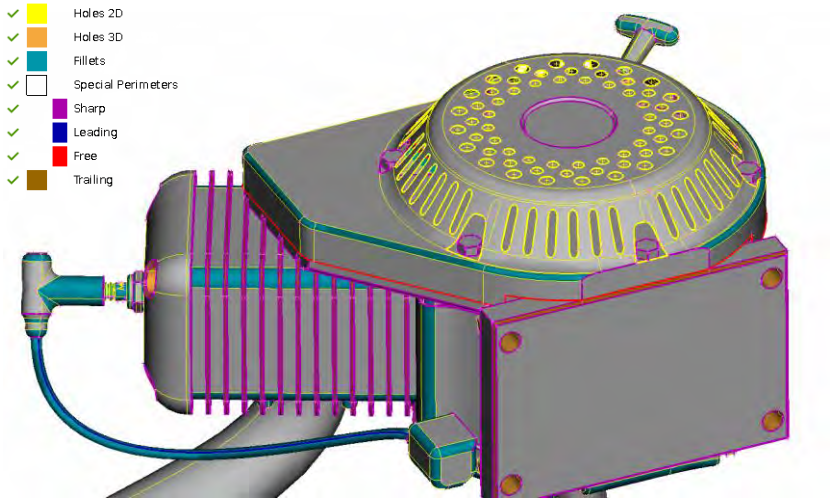
Linked geometry

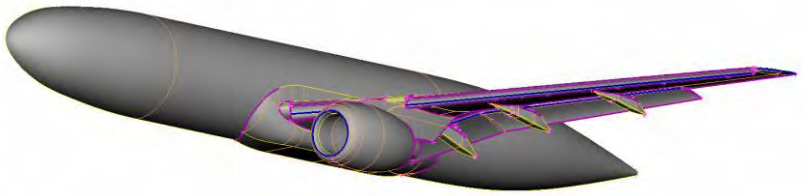
Link geometry available for symmetric or periodic (rotation or translation) similar geometry allows the generation of compatible identical meshes on each side in a straightforward manner

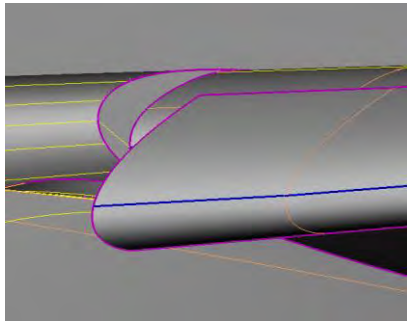


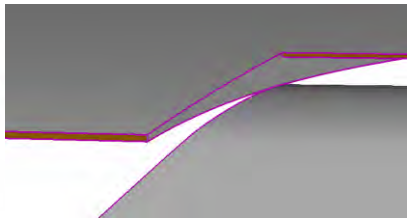
Geometry creation from surface mesh

Automatic creation of geometry from surface mesh based on intelligent perimeter identification algorithm.









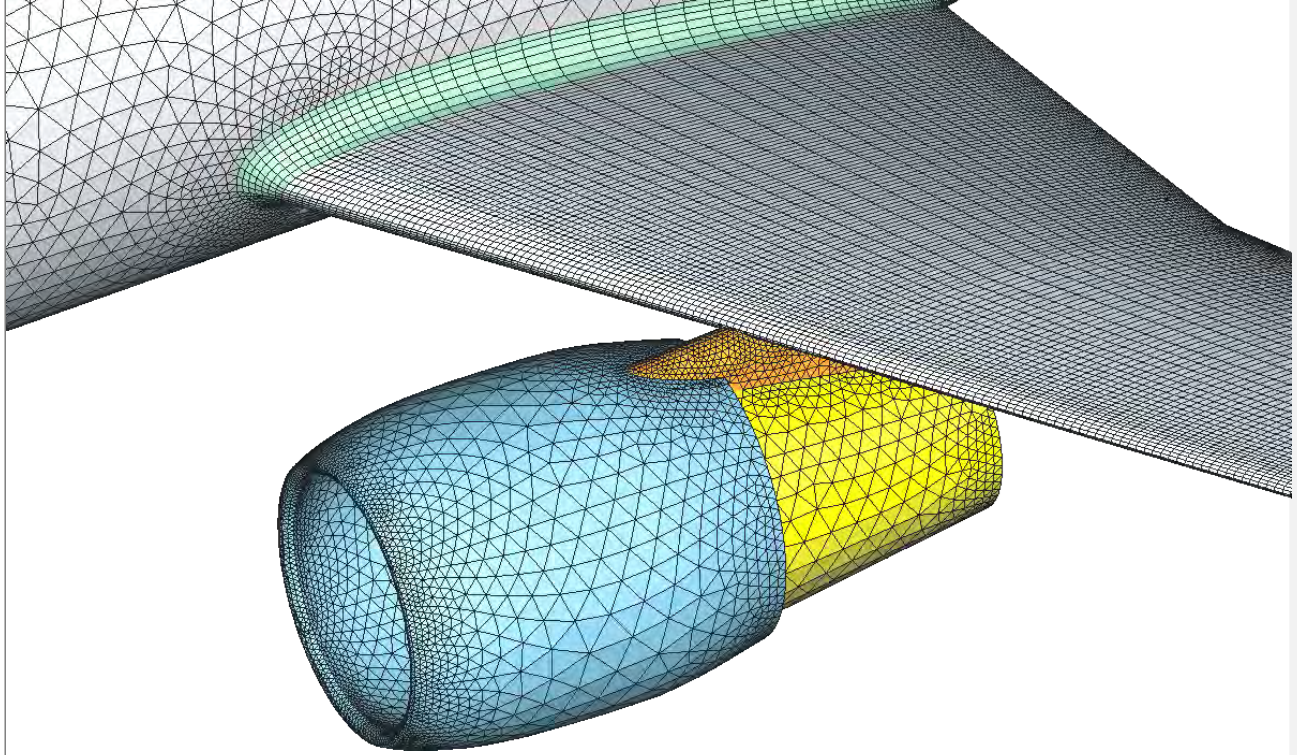
Auto-detection of geometrical features

- Sharp edges
- Leading edges
- Trailing edges
- Fillets
- 2D/3D Holes

and more..

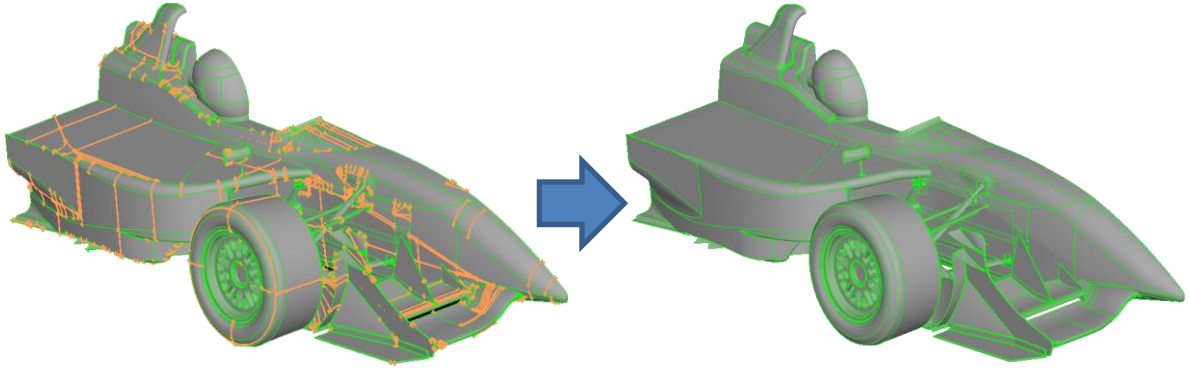
Features can be removed or meshed with specific meshing rules

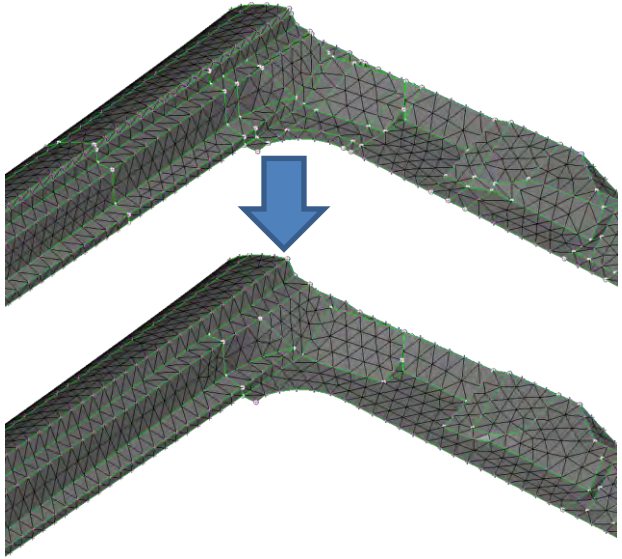
Surface Meshing

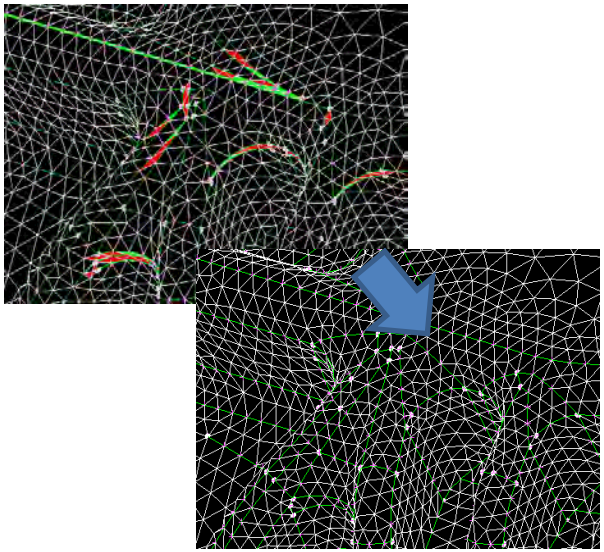


Surface Meshing

Multiple algorithms for tria, quad or mixed-type shell mesh

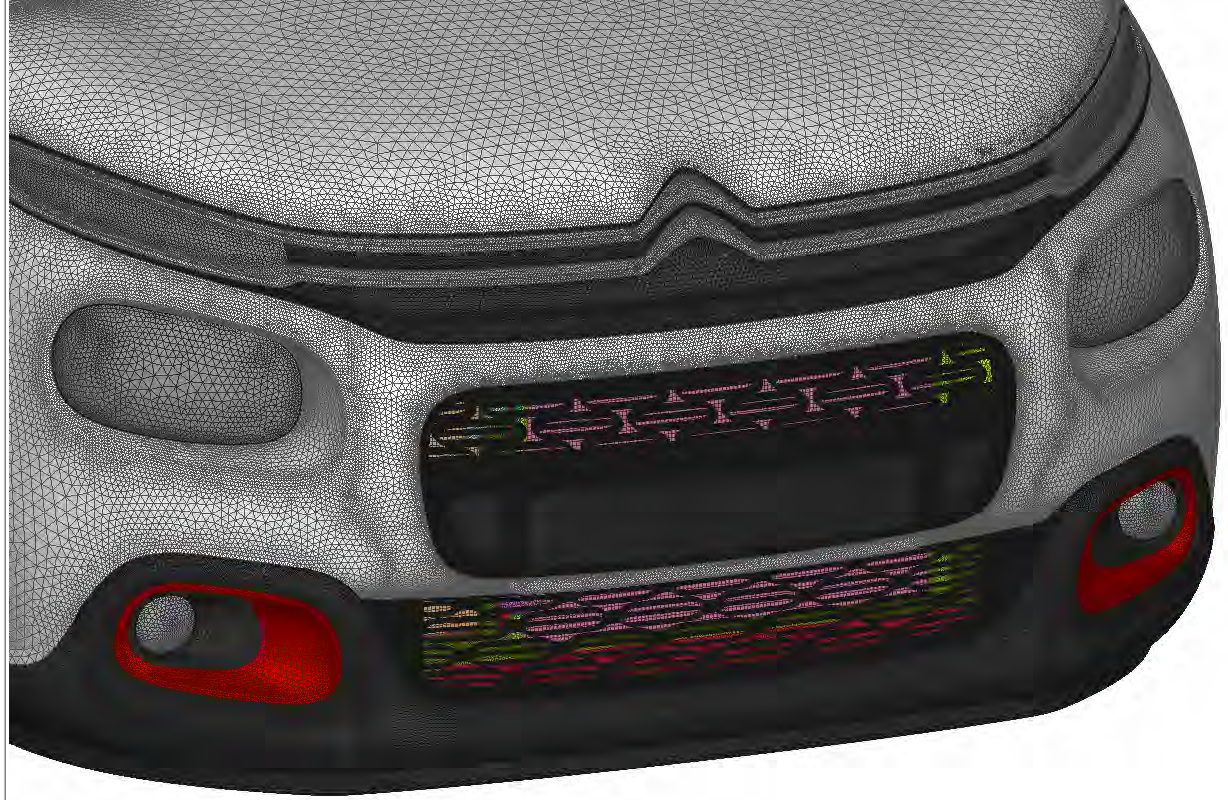






Surface Meshing

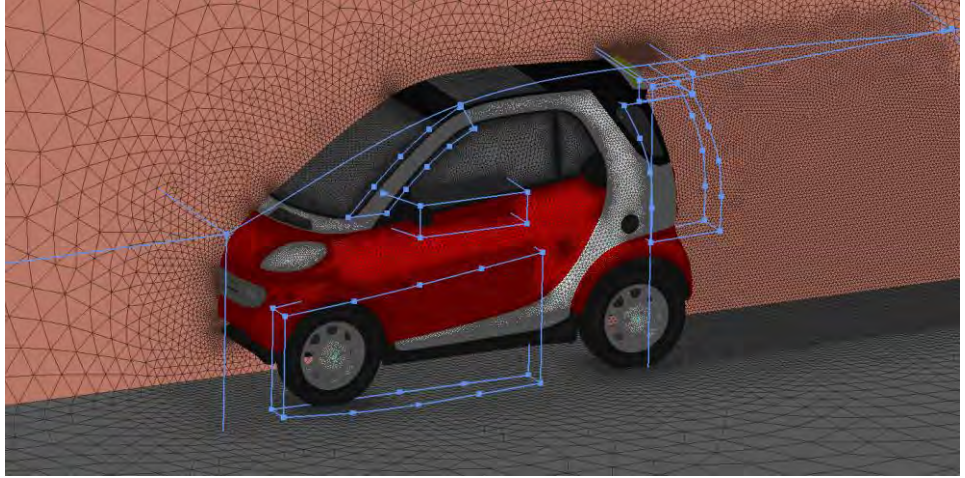
Automatic Macro Area merging for high quality surface mesh

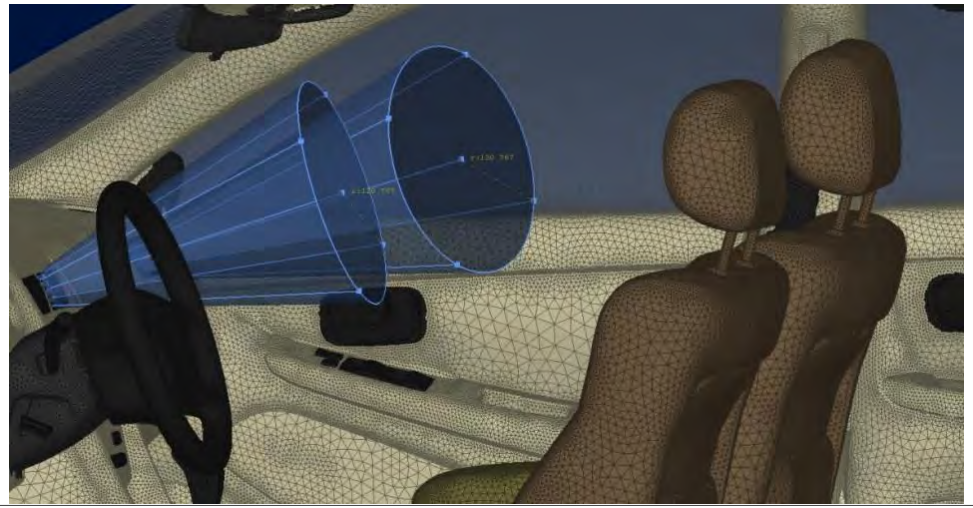


Courtesy of PSA

Surface Meshing for CFD

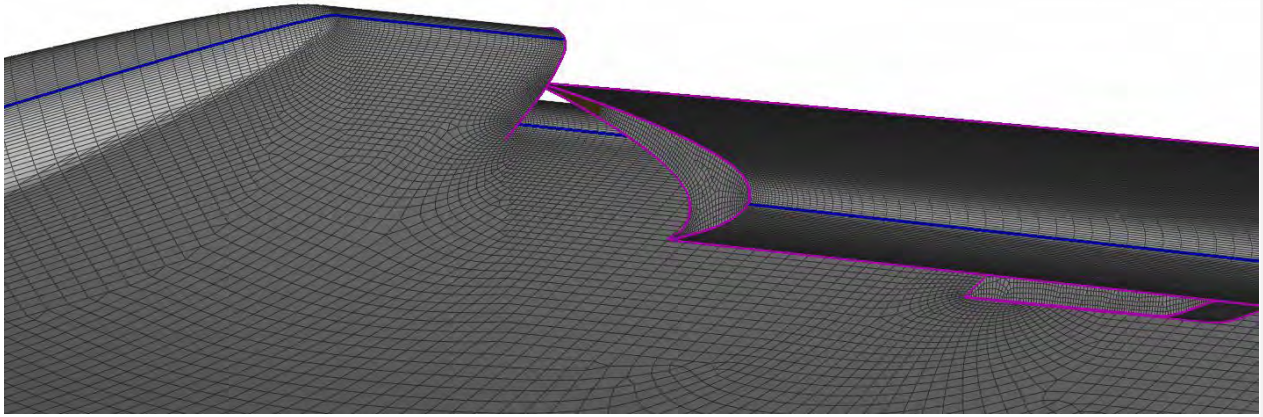
Fully automatic surface meshing resolving all curvatures and sharp edges

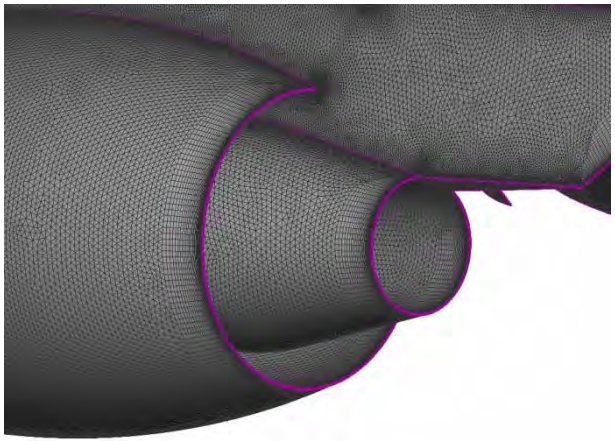


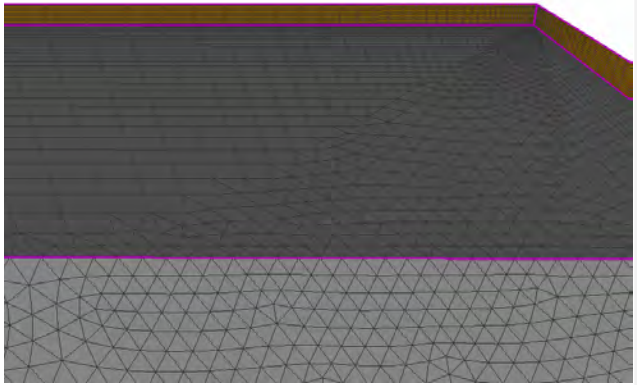


Flexible size boxes for mesh refinement

Size Boxes of arbitrary shape for local surface mesh control

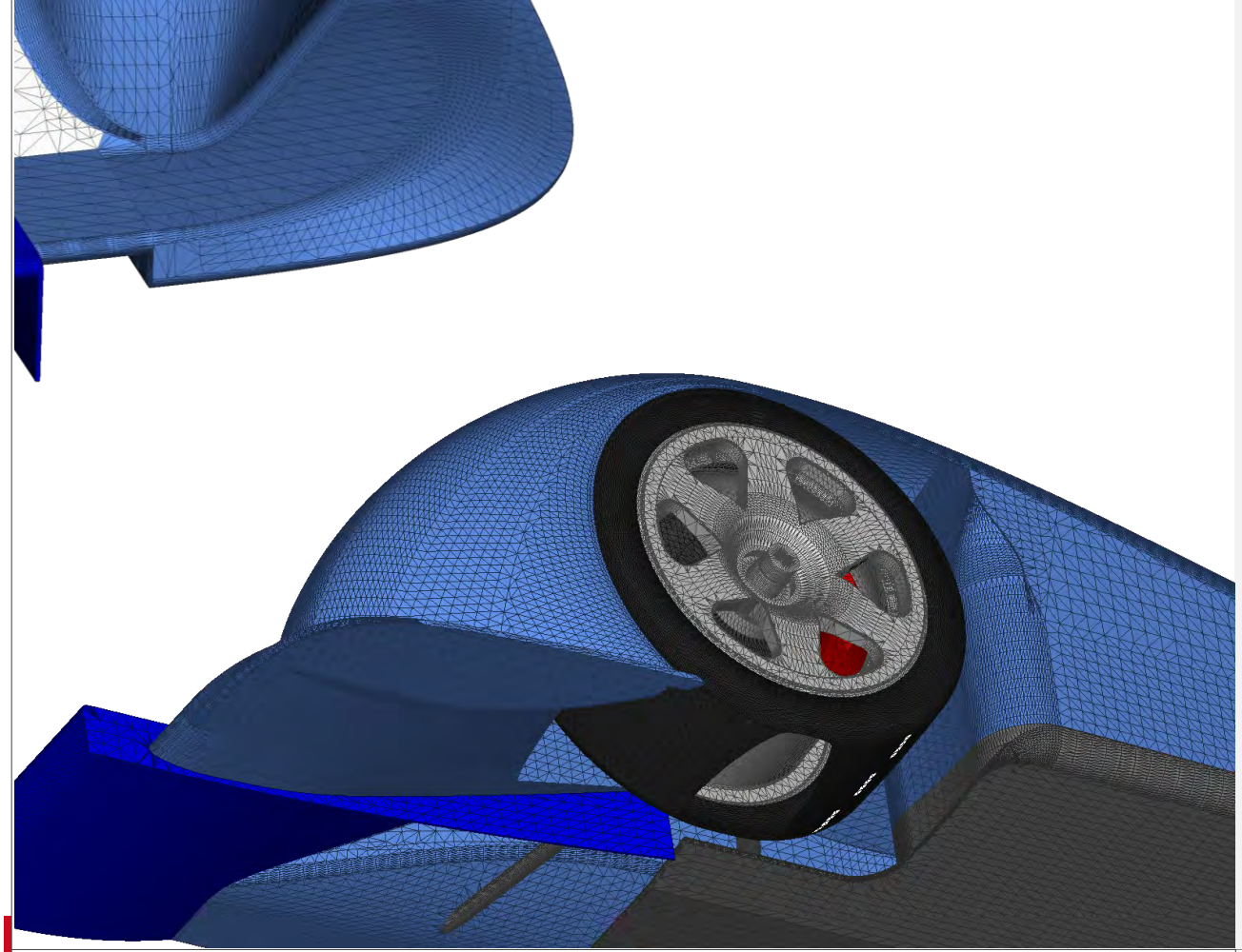






Fully automatic anisotropic mesh for aerospace applications

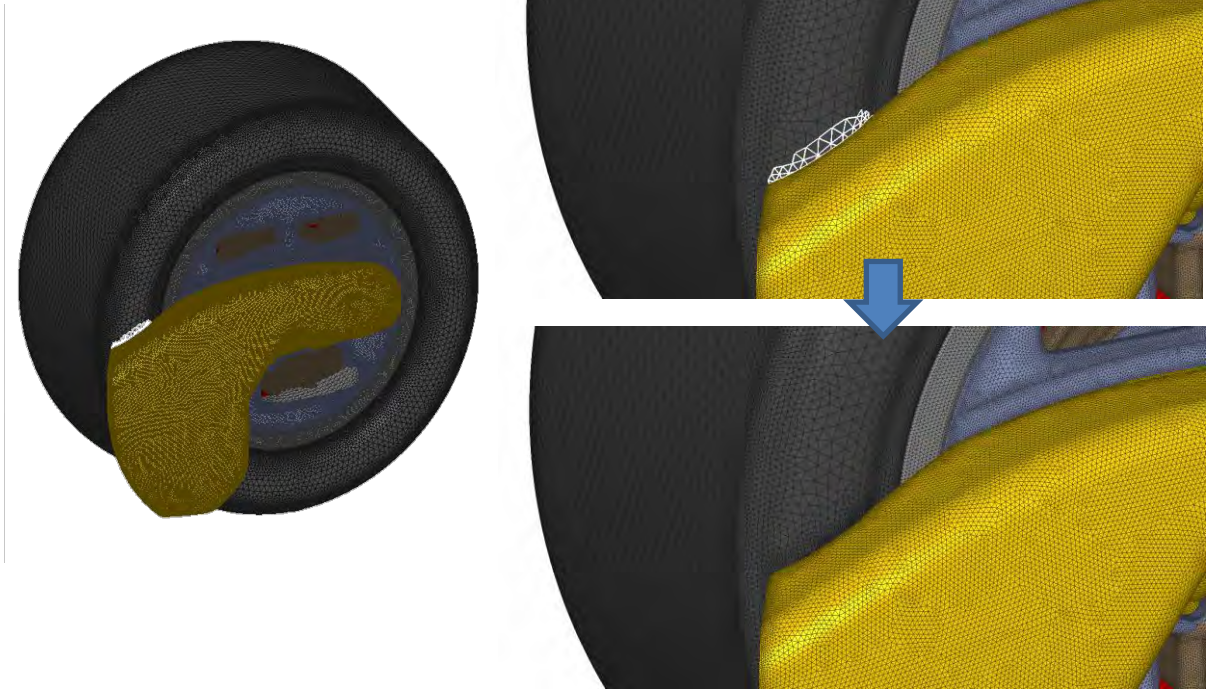
Quad or tria anisotropic mesh



STL meshing

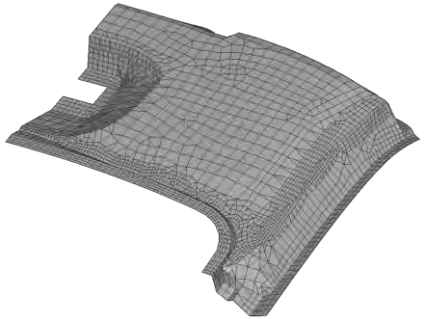
For Lattice Boltzmann codes, like:

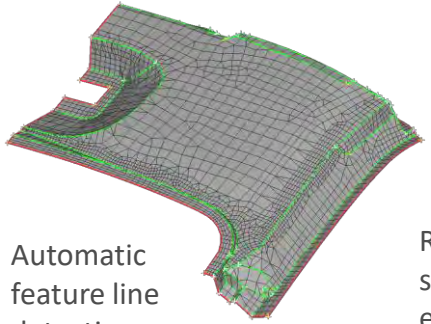
- ProLB
- Powerflow
- XFlow



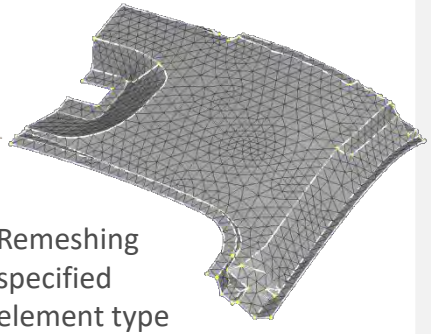
Proximity detection and refinement

Proximity detection in shell mesh and auto-refinement

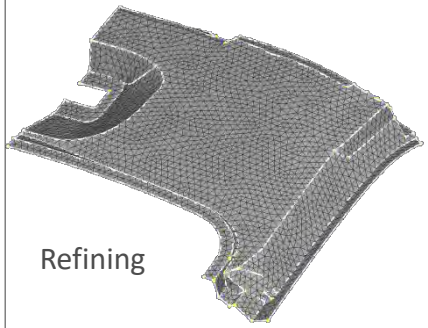




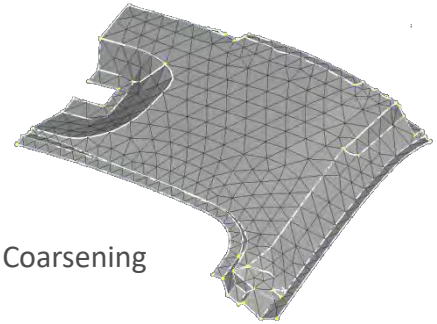
Automatic feature line detection



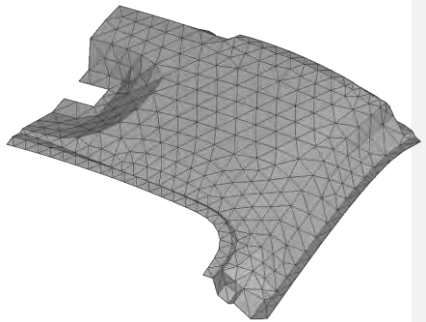
Remeshing specified element type



Refining

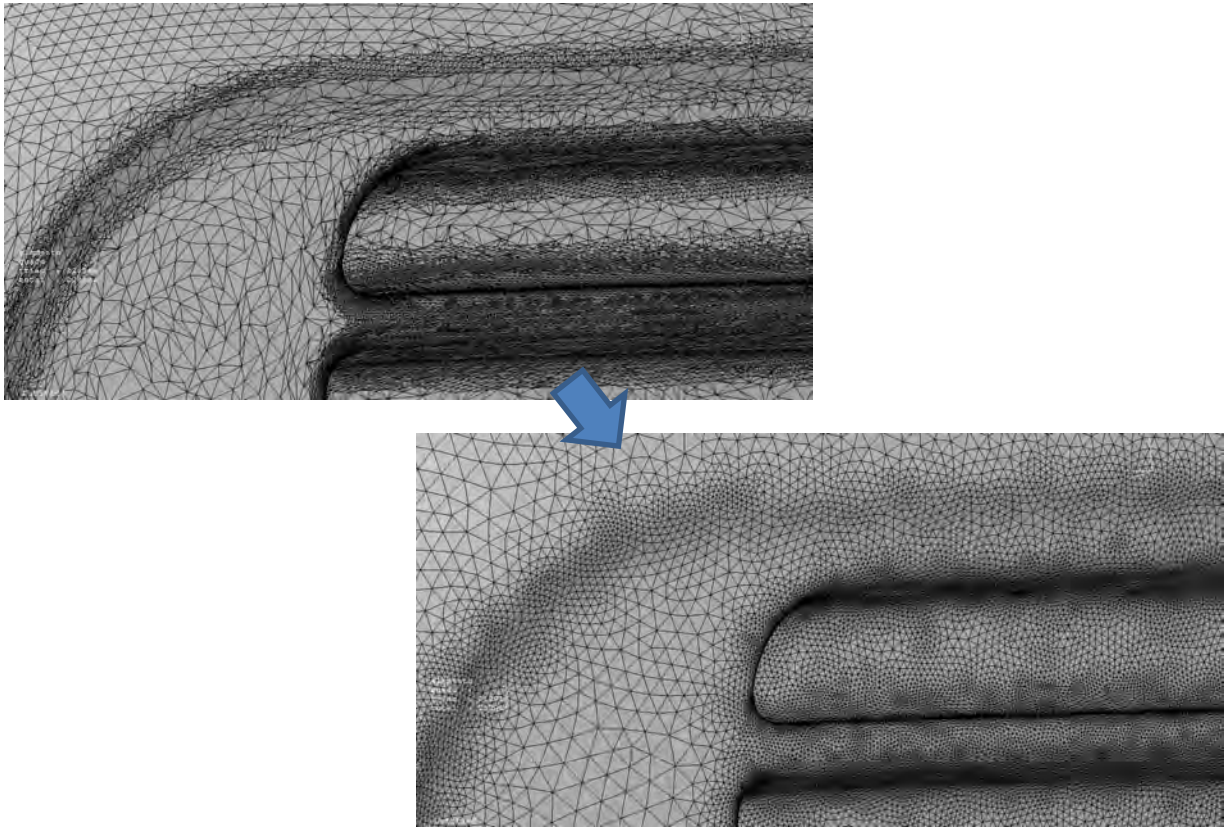


Coarsening



Surface mesh reconstruction

Reconstruction of existing FE-model mesh for element type modification, quality improvement, refinement, or coarsening, capturing all feature lines of the model

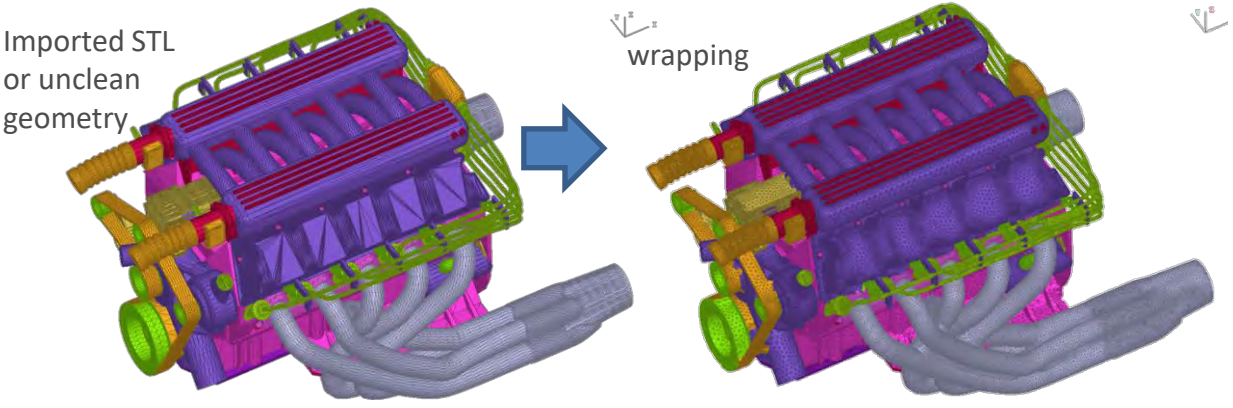


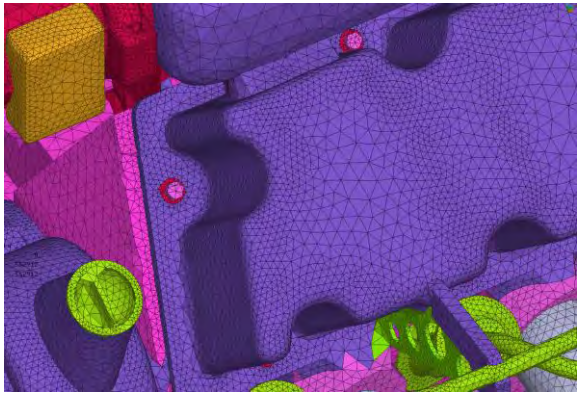
Surface mesh reconstruction

Reconstruction of bad quality STL mesh respecting local size and curvature

Surface wrapping

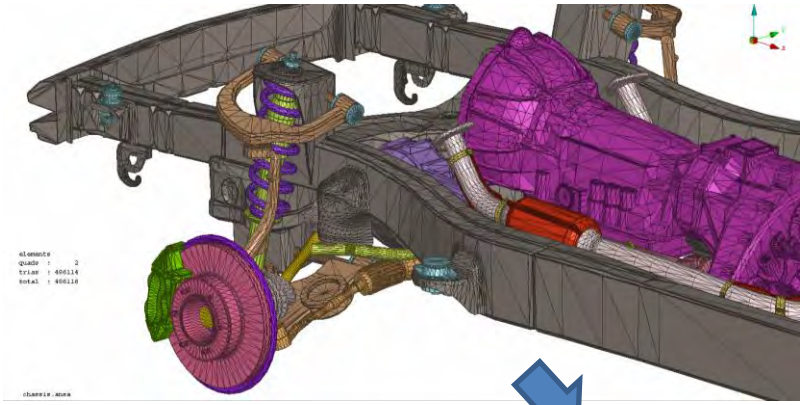
Variable length Wrapping, capturing local curvature and model feature lines



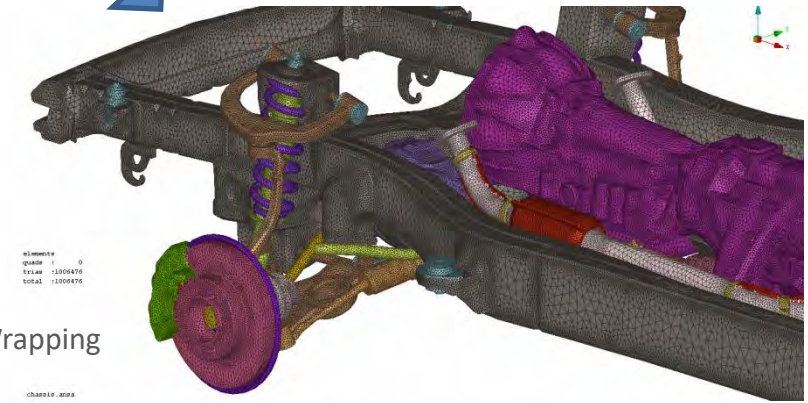


Surface wrapping

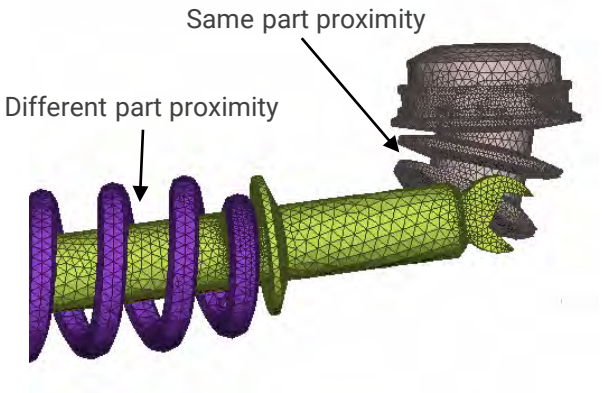
Variable length Wrapping, capturing local curvature, model feature lines with proximity refinement and contact prevention

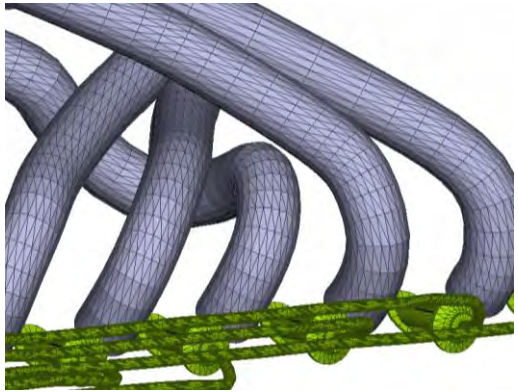


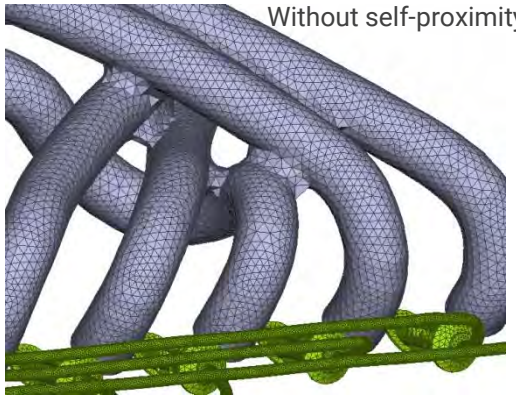
Input STL data
Treatment (hole and gap closure)

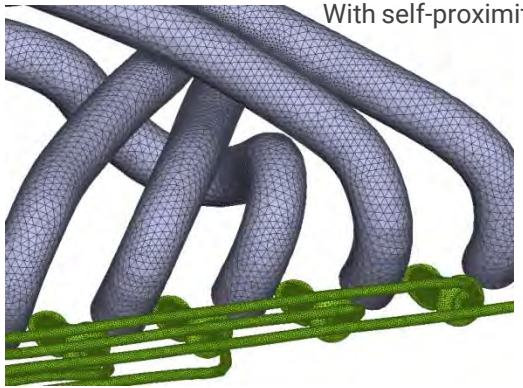


Surface Wrapping



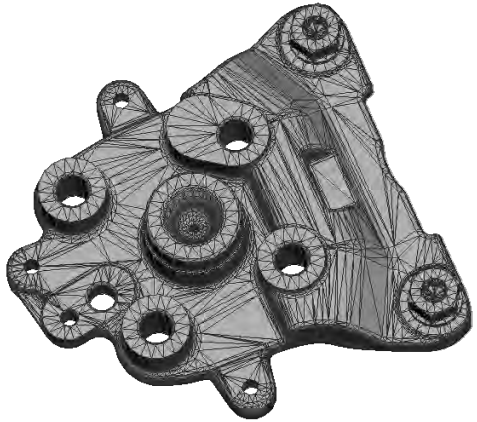


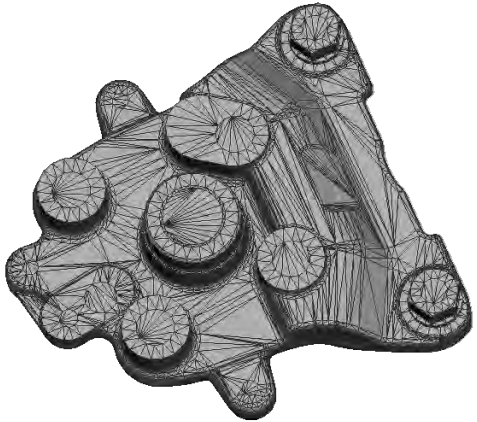




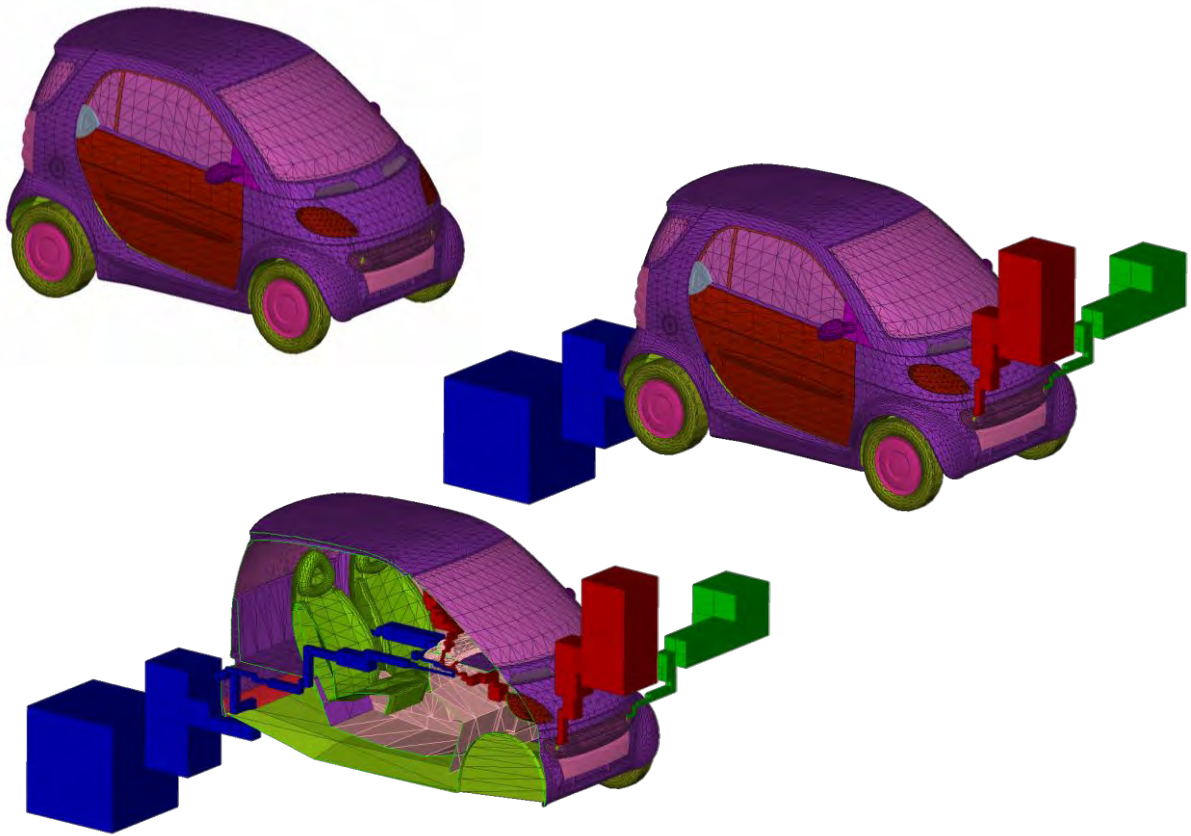
Proximity refinement in surface wrapping

Ability to specify proximity refinement settings to avoid fused areas between different or same parts





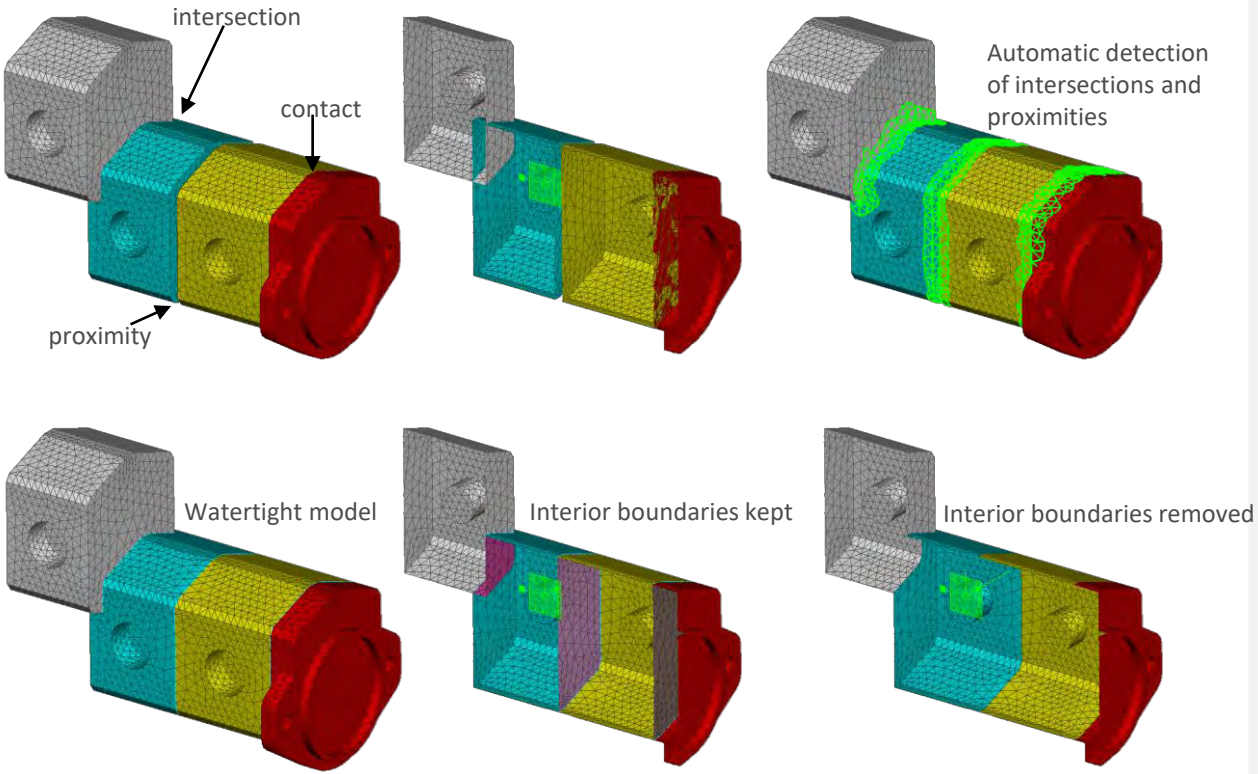
Automatic detection and closure of gaps and openings



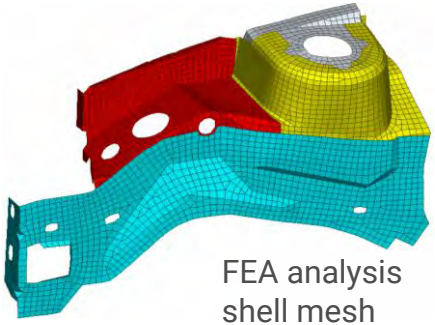
Leak detection tools

Fast leak detection functionality with interactive cut plane visualization and automatic leak closure

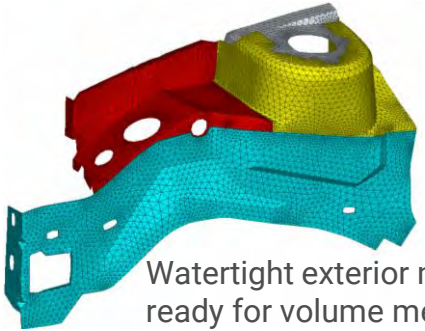
Watertight model creation for intersections, contacts and proximities



Efficient creation of models for e-coat simulations starting from FEA mesh



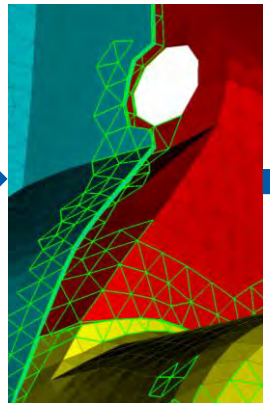
FEA analysis shell mesh



Watertight exterior mesh ready for volume meshing for e-coat CFD model

Triangulated shell mesh

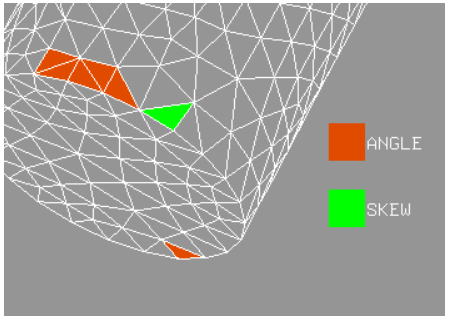
Volumized mesh according to property thickness

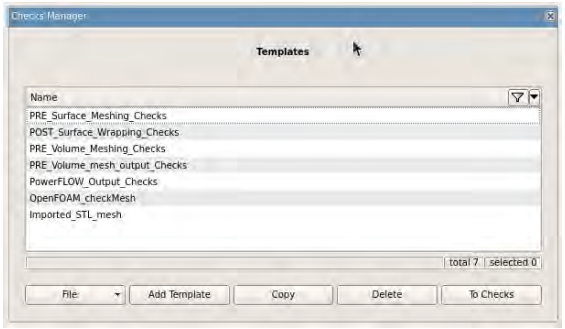


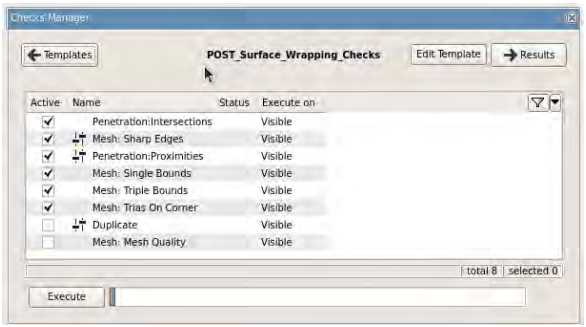
Automatic fusing of contacts and proximities

Final watertight mesh with all necessary details

Surface mesh checks





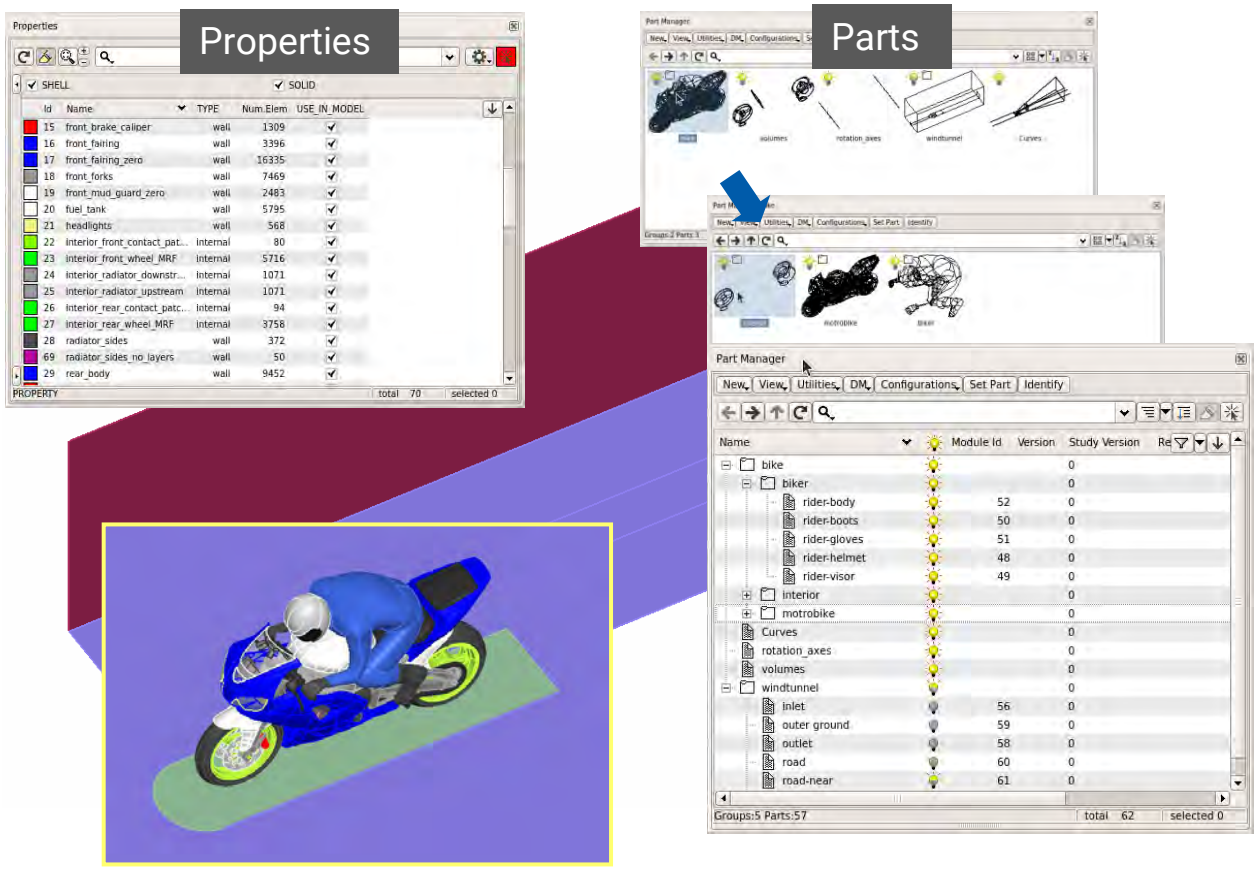


Template controlled mesh integrity checks (locate unmeshed areas, free edges, proximities and penetration areas, duplicate elements etc.)

Comprehensive mesh information and quality statistics

Quality check according to multiple criteria (skewness, angle squish, length, aspect, warp, etc.) and solvers (Fluent, Star, OpenFOAM etc.)

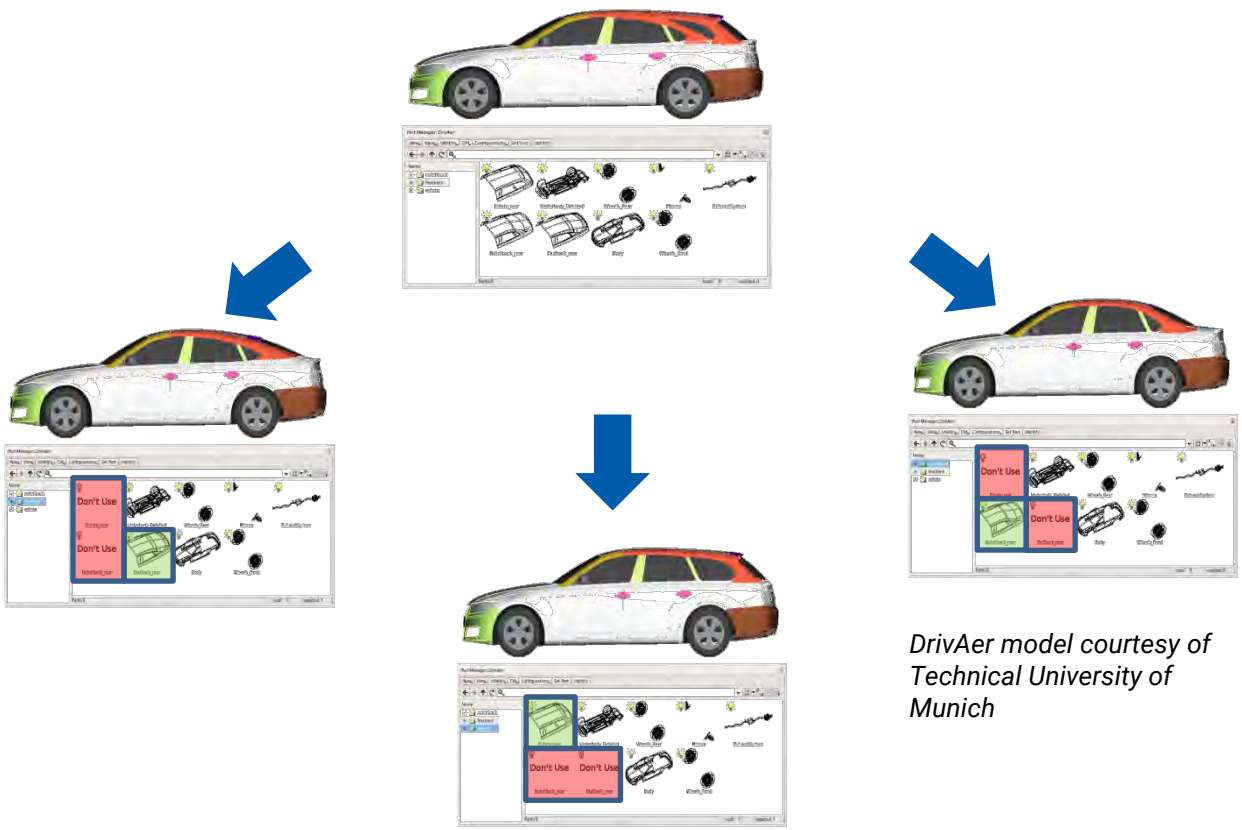
Clear identification of poor-quality elements



CFD model management

Double parallel model management tools: Properties (corresponding to CFD model zones) and Parts (assembly hierarchy extracted from CAD data)

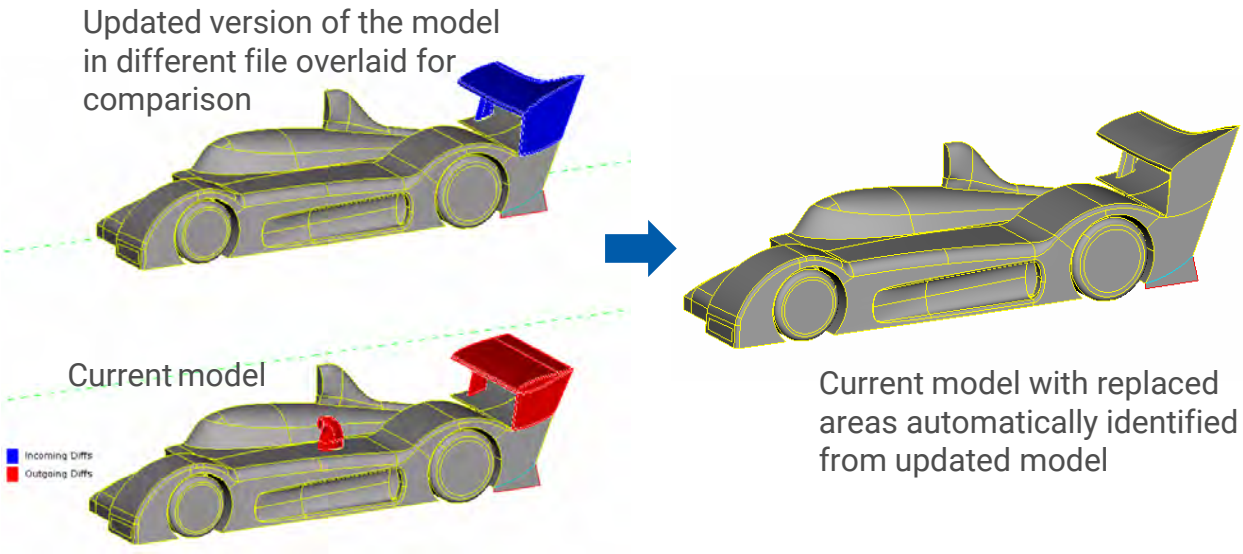
Configurations management of multiple variants



DrivAer model courtesy of Technical University of Munich

Advanced model comparison tool and local model updating

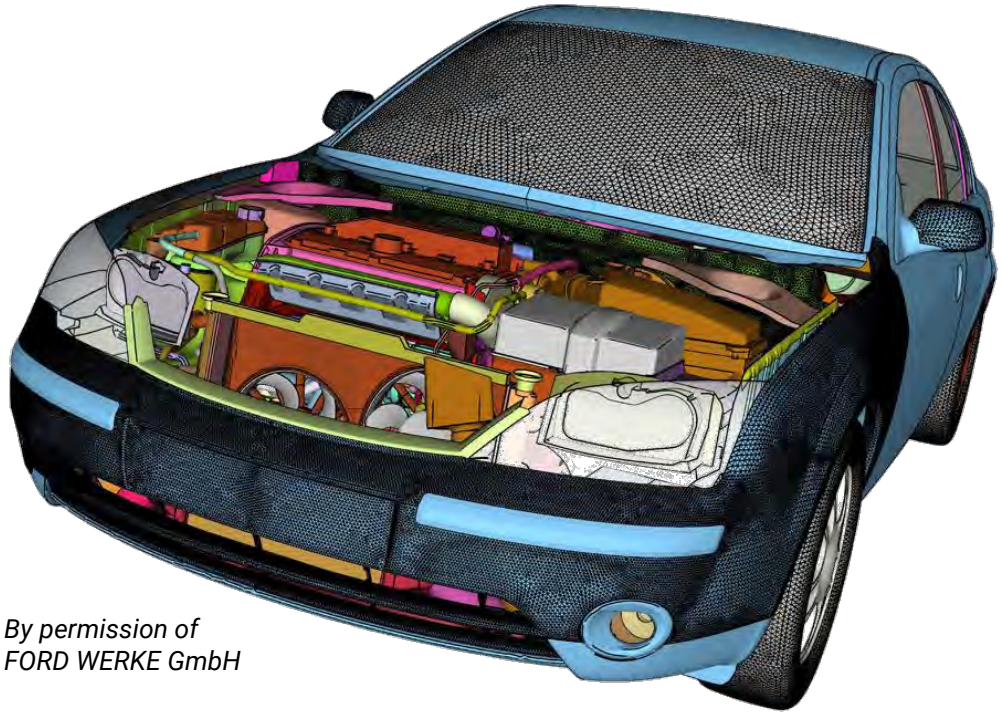
Functionality to compare current model with updates in other ANSA files, identify differences in geometry, or other attributes, and automatically update the current model with the necessary differences only



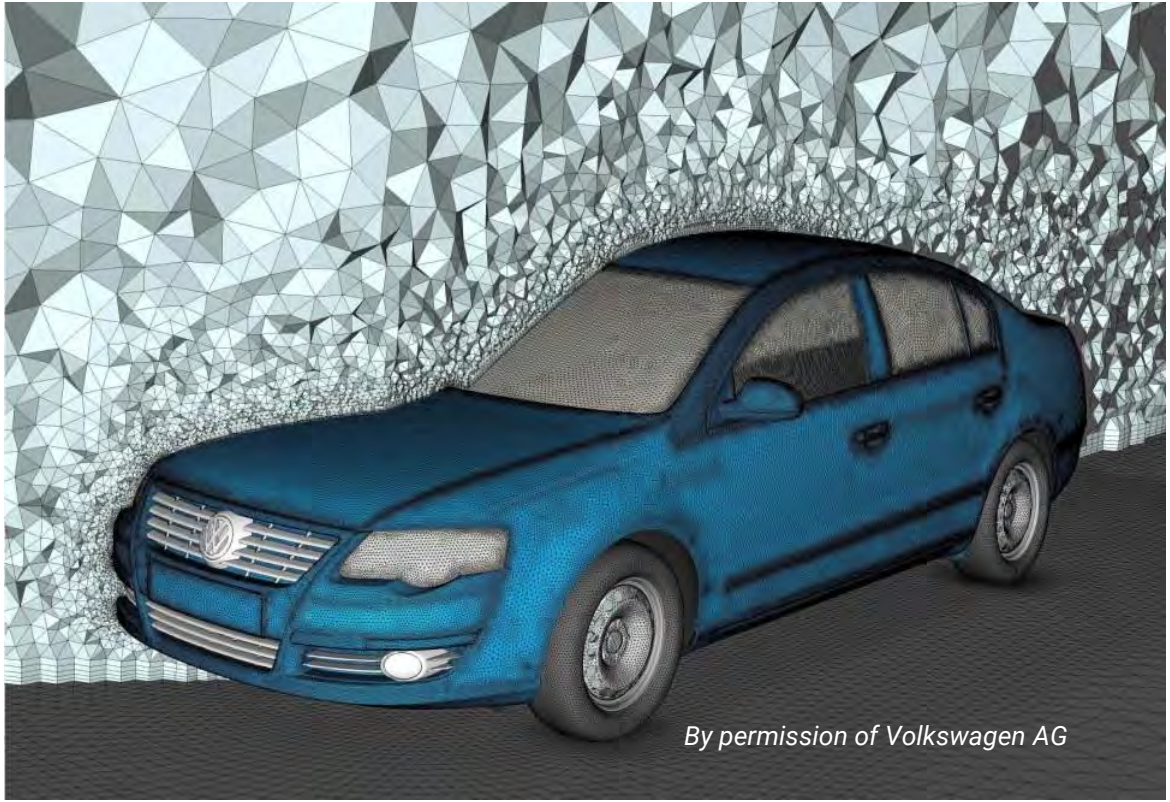
Volume meshing

Volume meshing

Fully automatic volume and sub volume detection applicable to the most complex problems



By permission of
FORD WERKE GmbH

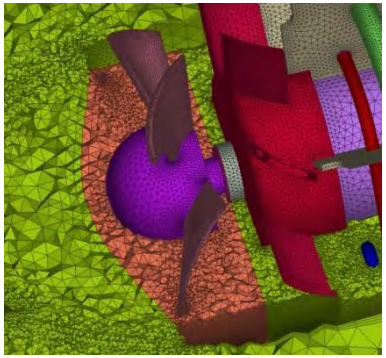


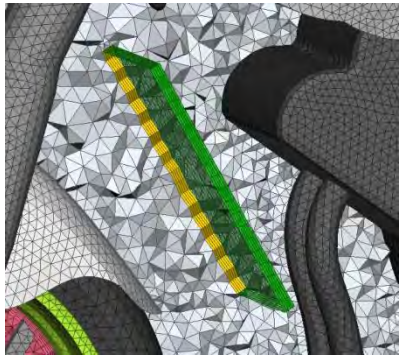
Volume meshing

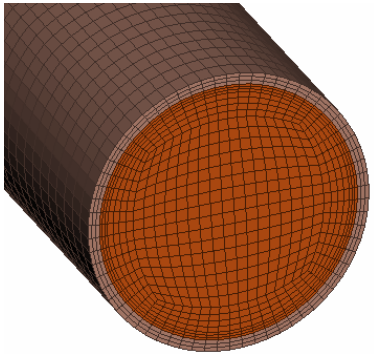
Fast and robust volume meshing for all types of elements (tetra, pyramid, prism, hexa and polyhedron)

Handling of multiple fluid and solid zones

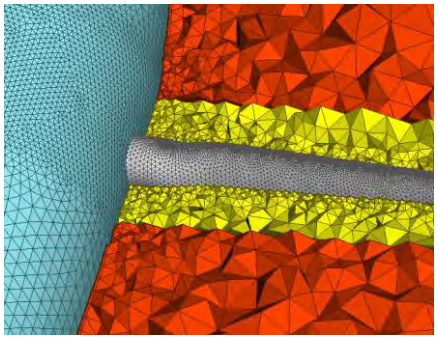
Conformal mesh for MRF and porous zones and for conjugate heat transfer analyses



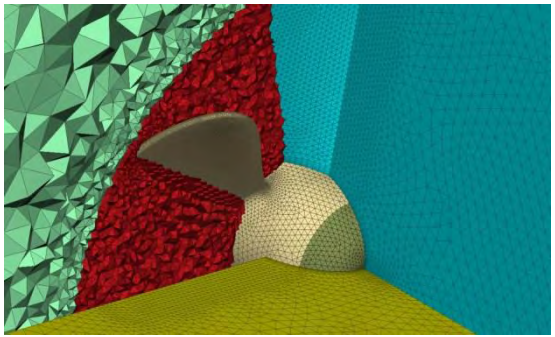




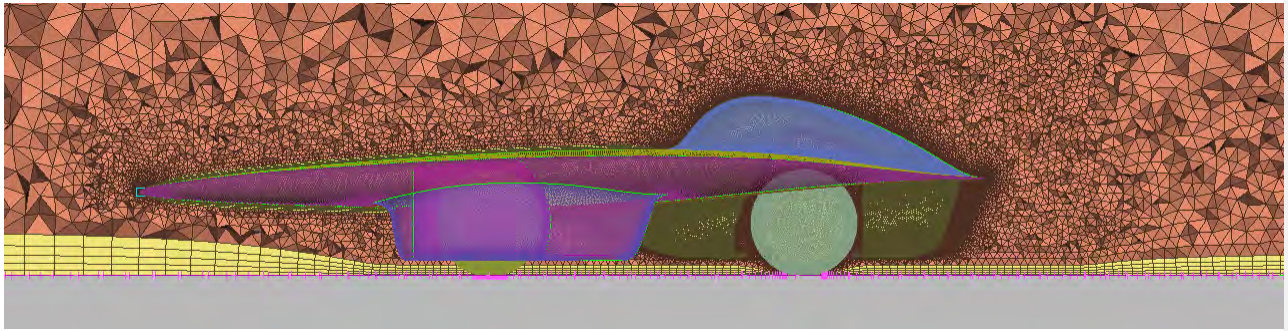
Non-conformal mesh for moving mesh analysis

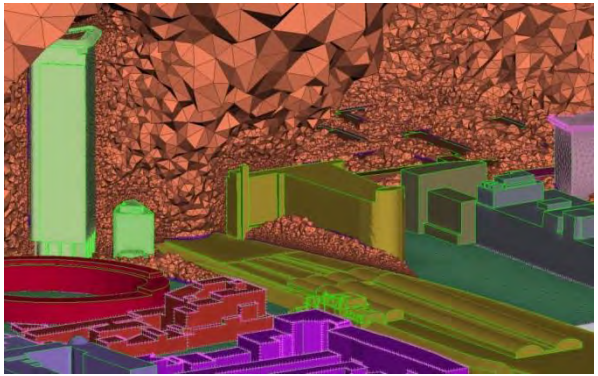


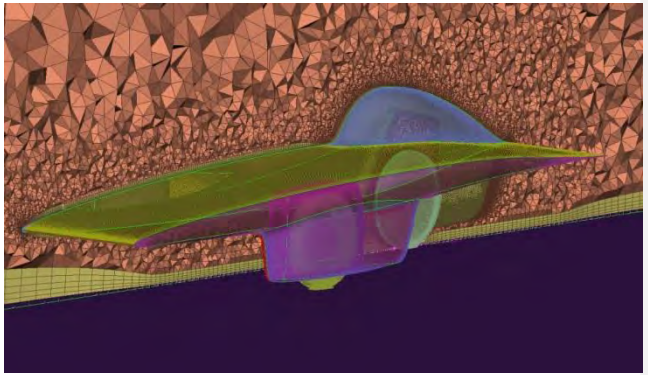
Periodic BCs matching node meshes



Solar car and urban environment simulations

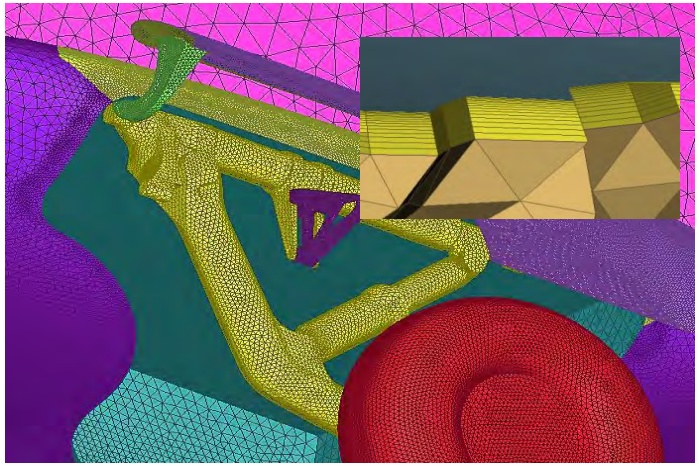


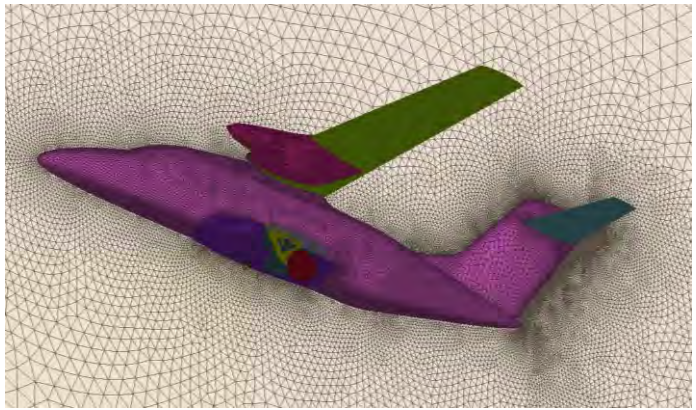




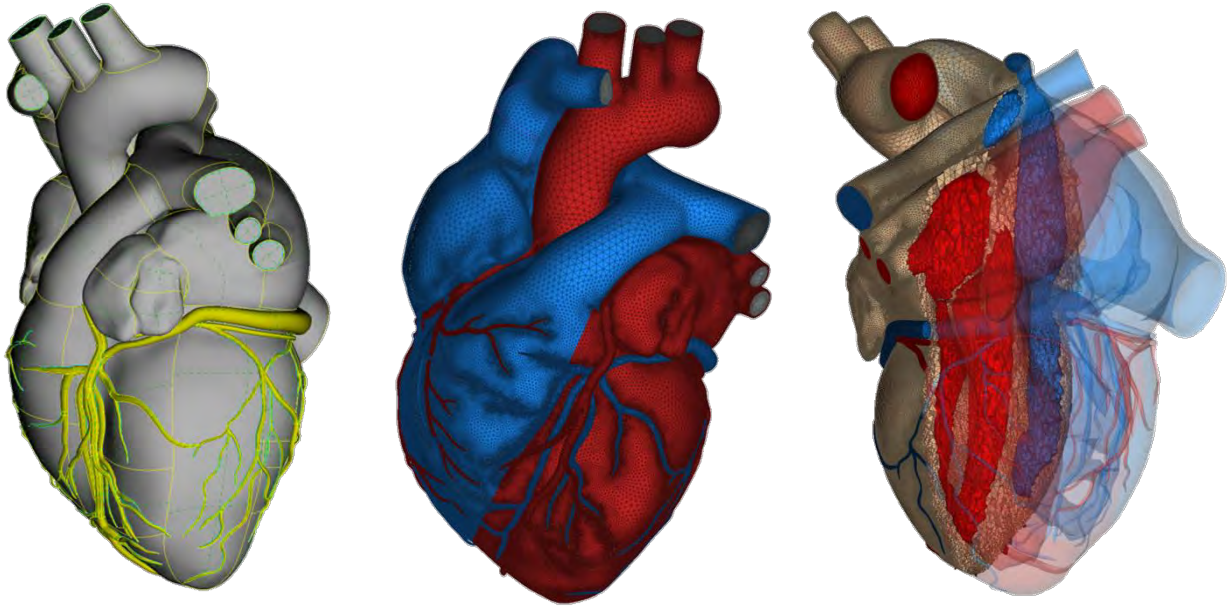
Courtesy of Actiflow BV

Aerospace case EV-55



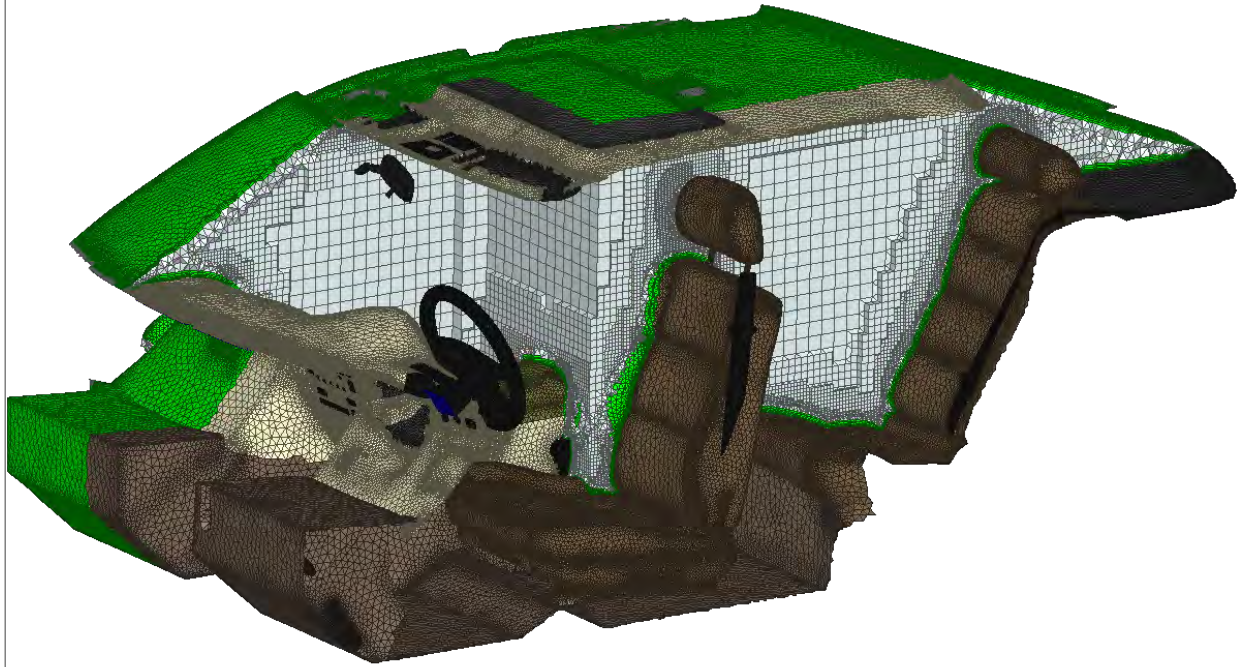


Courtesy of Evektor



Complete volume mesh of a human heart

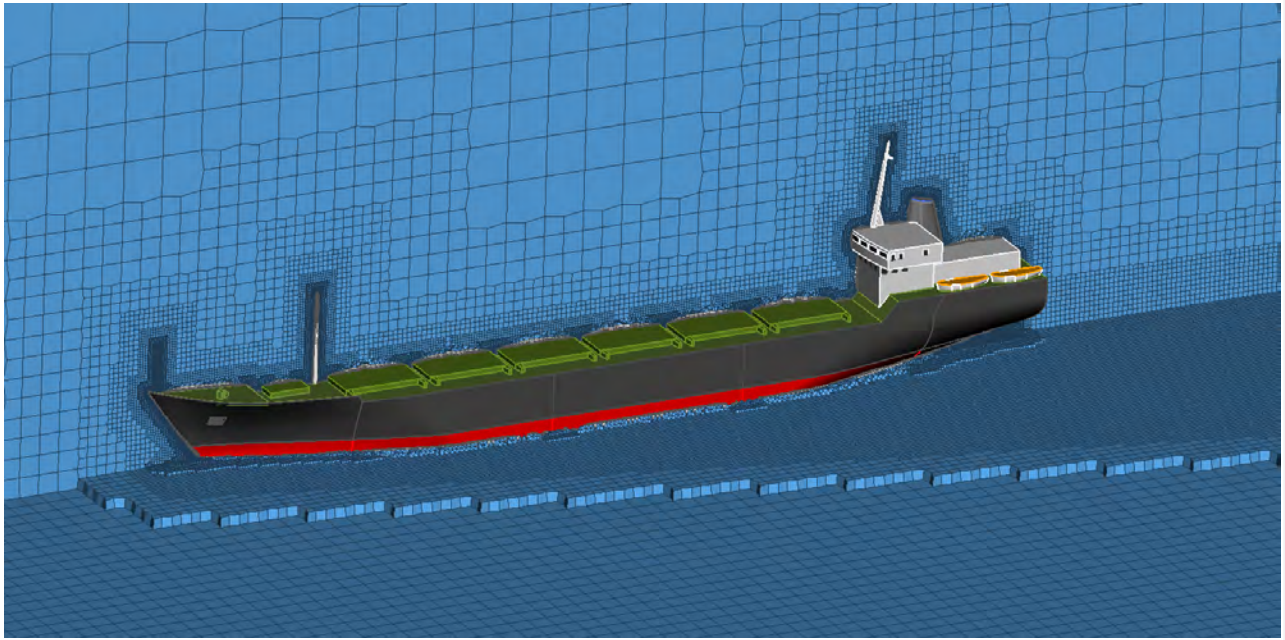
2 million trias, 23 million prisms and tetras



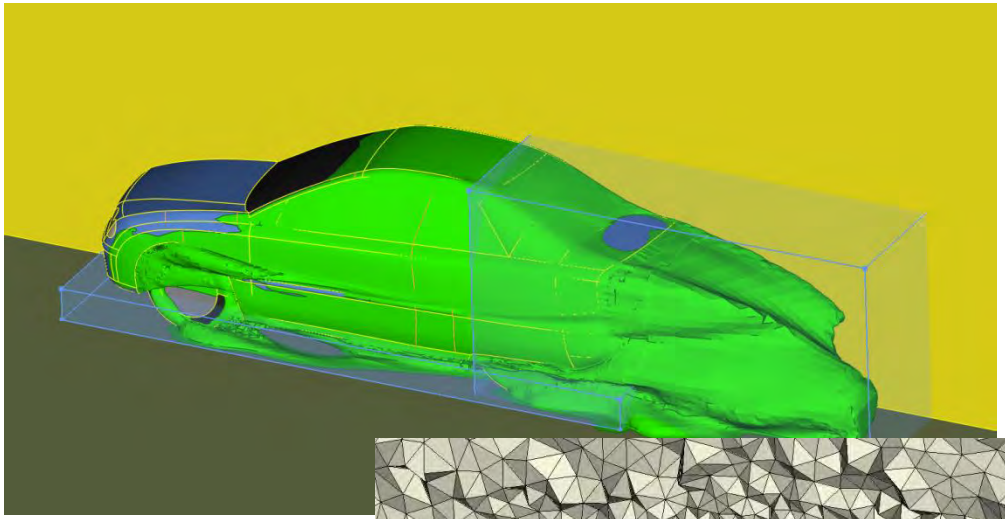
Hexa-Interior volume meshing

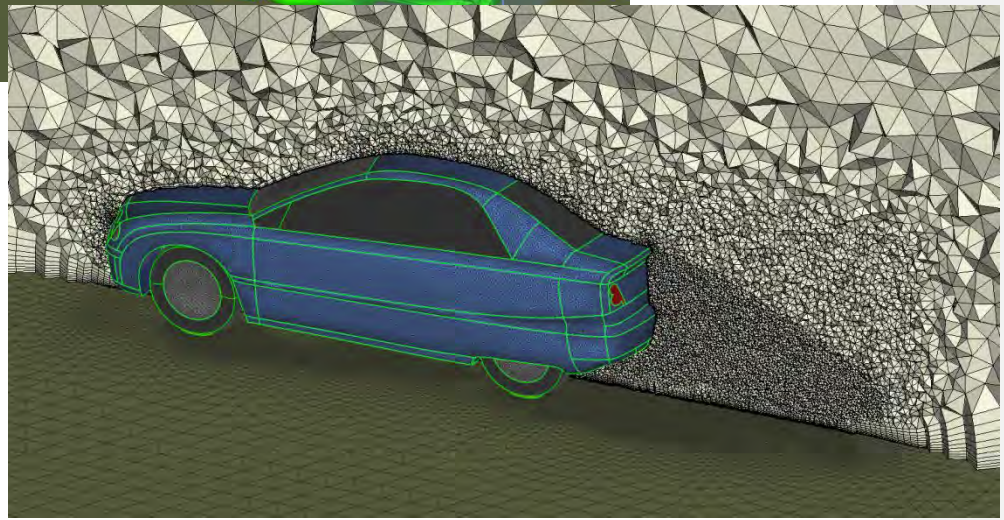
Fully-conformal variable size Hexa-Interior mesh with prism and pyramid transitions

HexaPoly volume meshing



Variable size hexa mesh with polyhedral elements for transitions

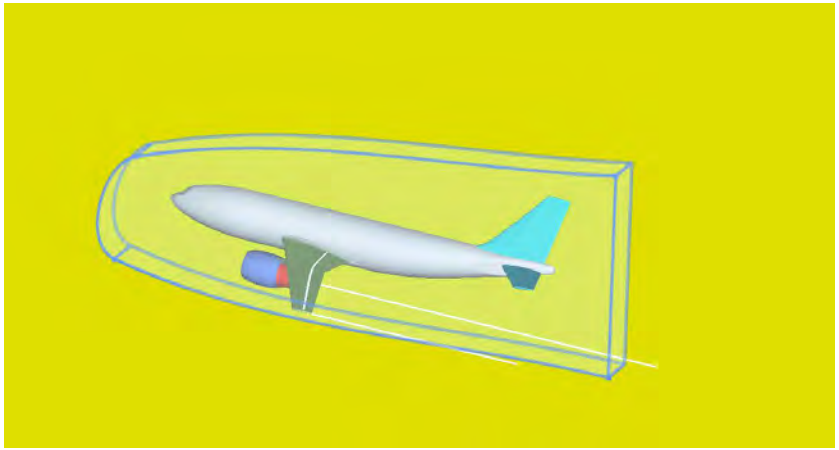




Size Field controls

Advanced functionality to control mesh size:

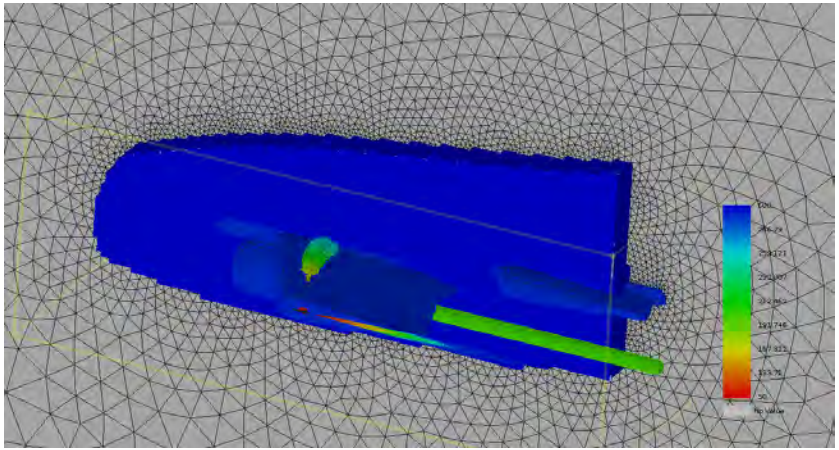
- Flexible Size Boxes
- Closed iso-surfaces

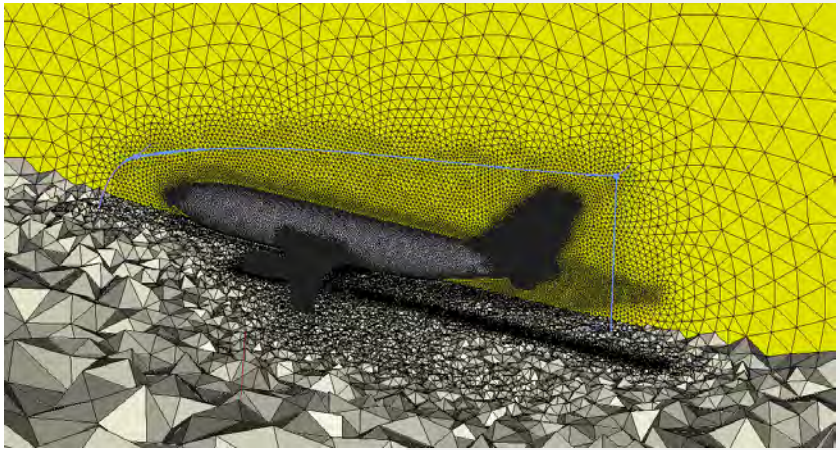


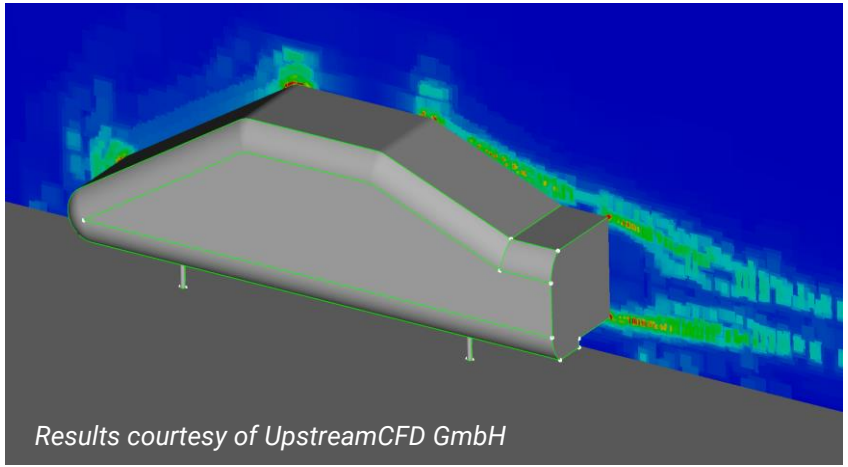
Size Field controls

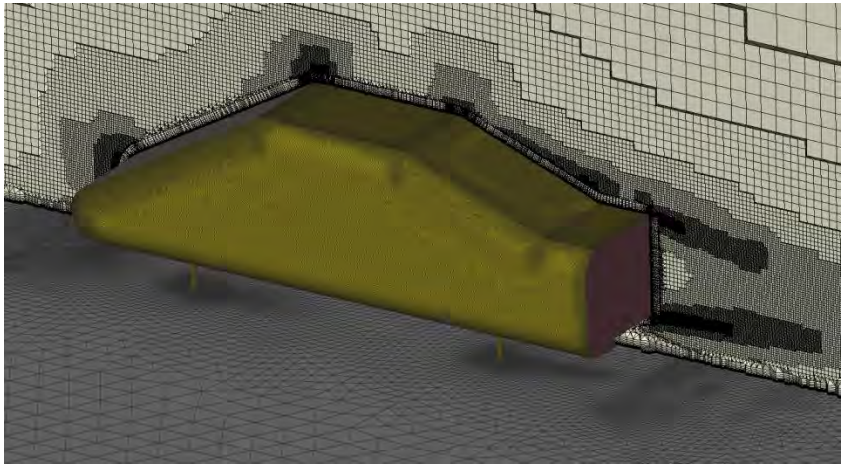
Advanced functionality to control mesh size:

- Offset surfaces
- Sweeping surfaces
- Point and Curve sources



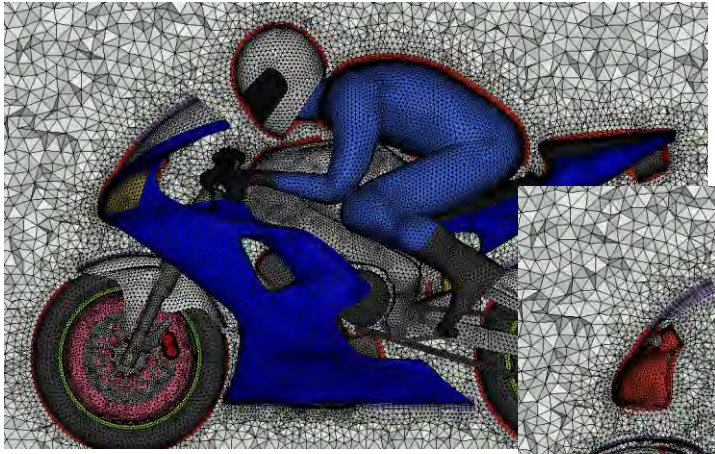


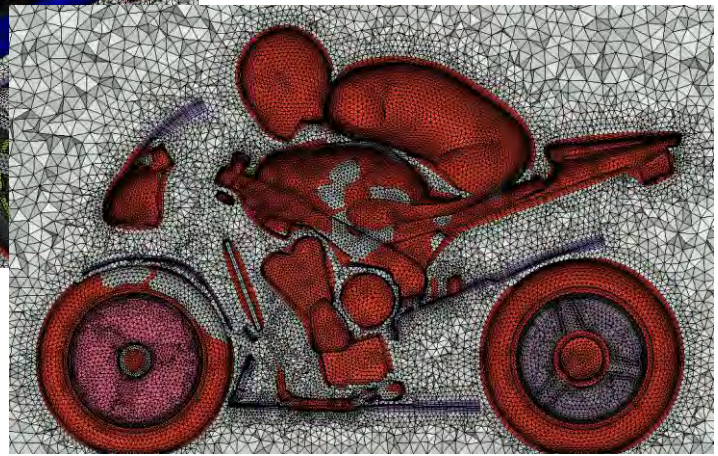


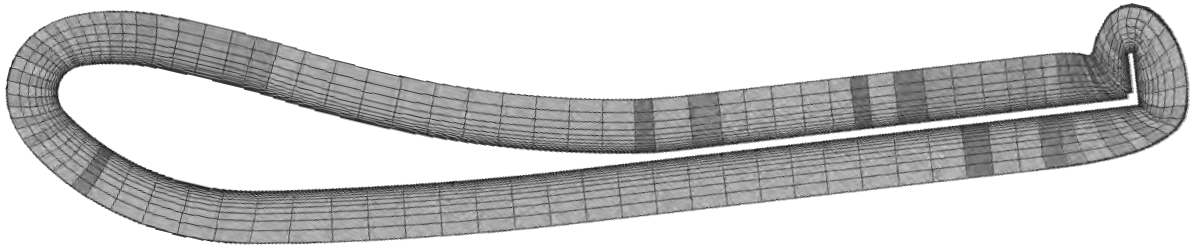


Solution adaption

Ability to read a size field from external solver and generate a mesh based on the specified lengths



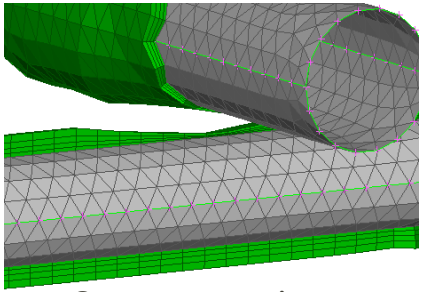




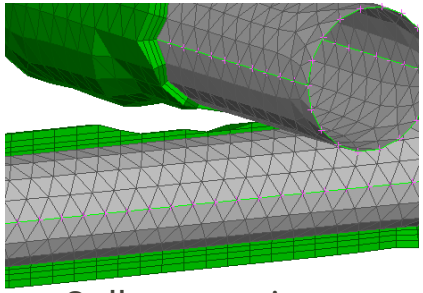
Advanced boundary layer generation functionality

Multiple options:

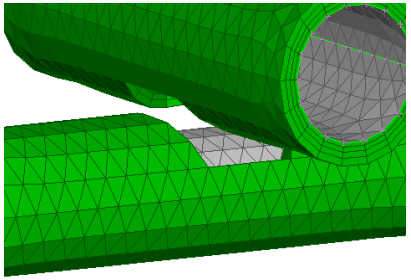
- Auto exclude or collapse areas
- Controlled Layer Squeezing to avoid intersections
- Layers from selected areas with different settings
- Layers from zero-thickness walls
- Layers with variable growth rate per layer



Squeeze option



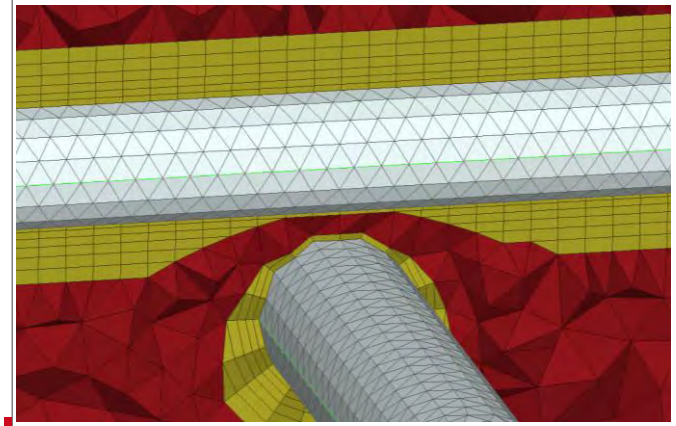
Collapse option

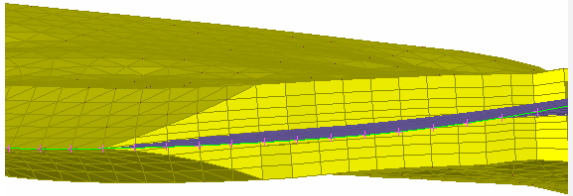


Exclude option

Boundary layer collision avoidance modes

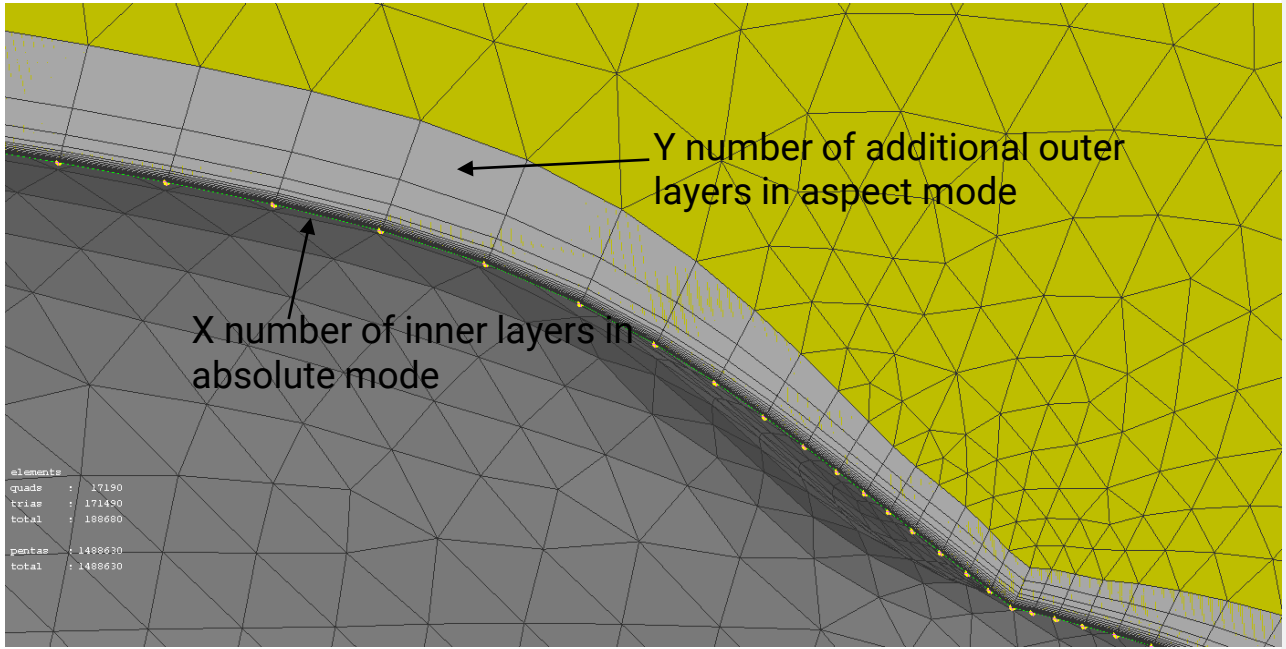
Automatic fix of intersection and proximities in any of three options



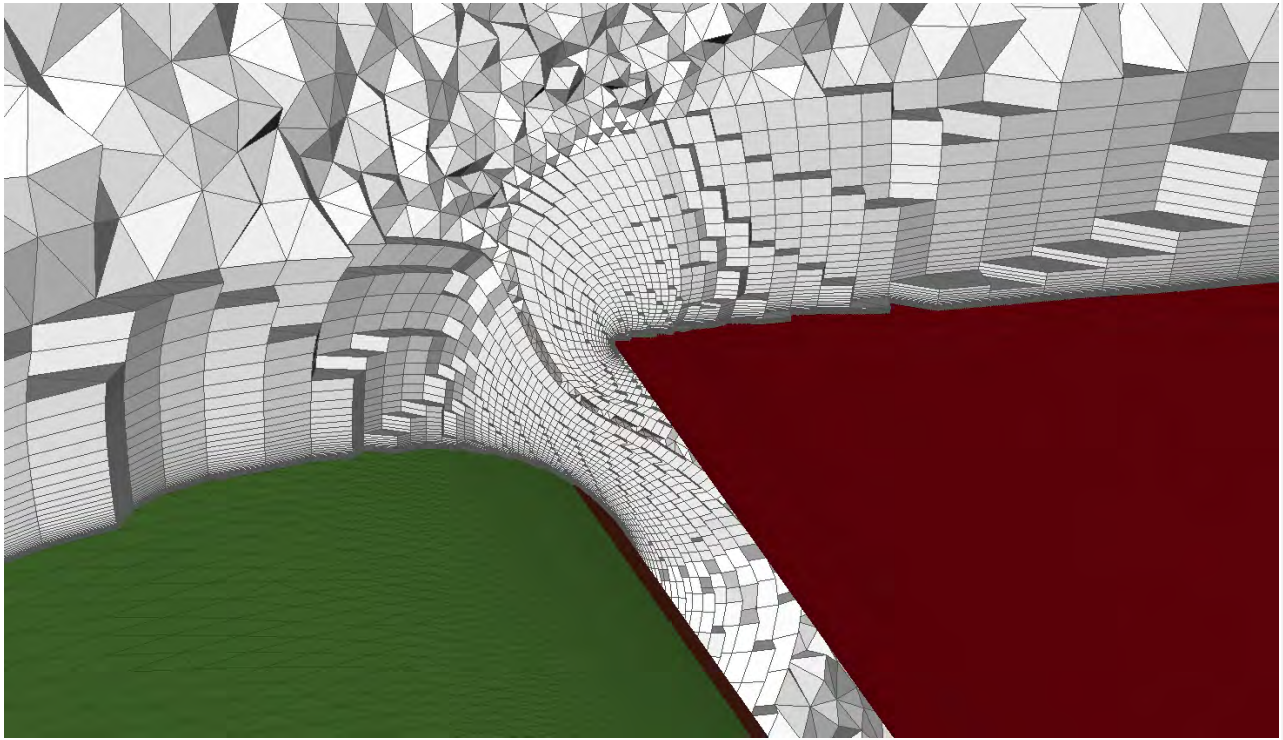


Collapse free edges

Flexible specification of layer growth



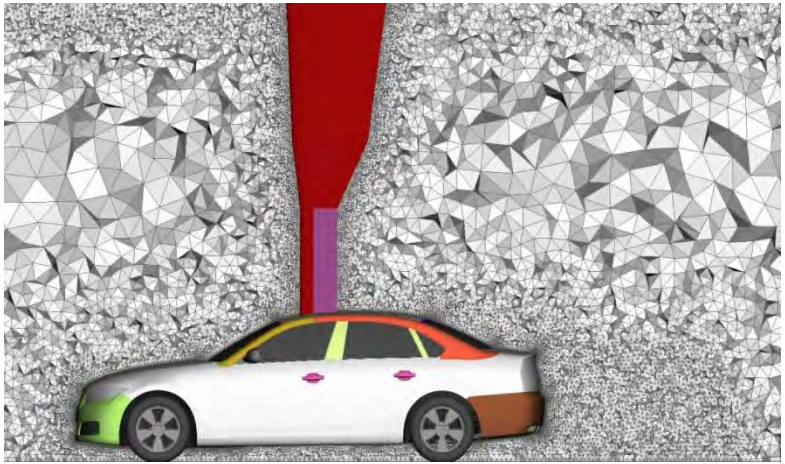
Ability to create an X number of layers in absolute height mode and then switch to aspect mode for the outer additional layers, thus ensuring a good cell volume change between the layers and the tetra mesh

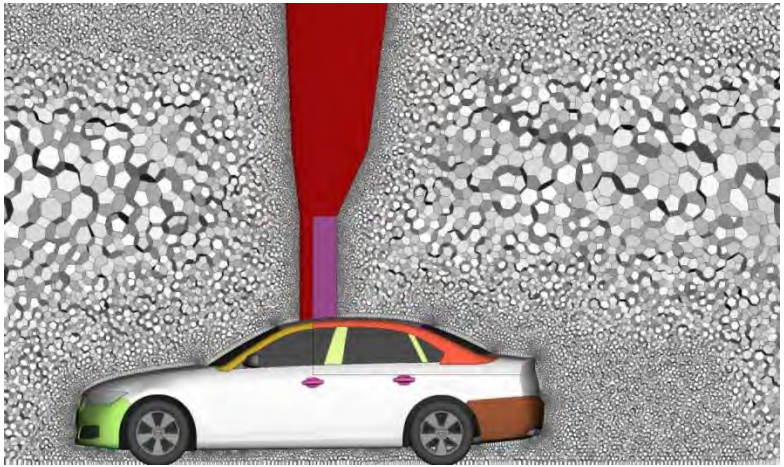


Robust layers generation at extreme heights and proximities

Powerful algorithm for very large total layer height and severe proximities

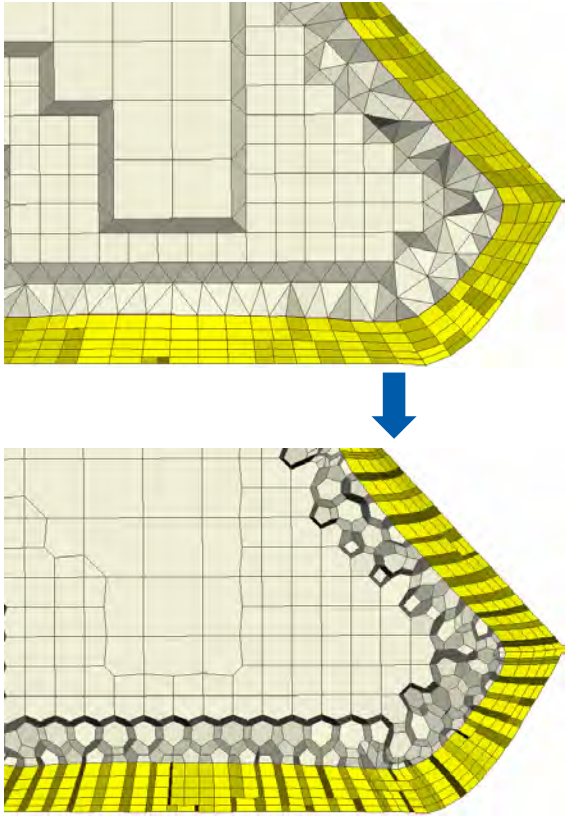
Conversion of hybrid meshes to polyhedral



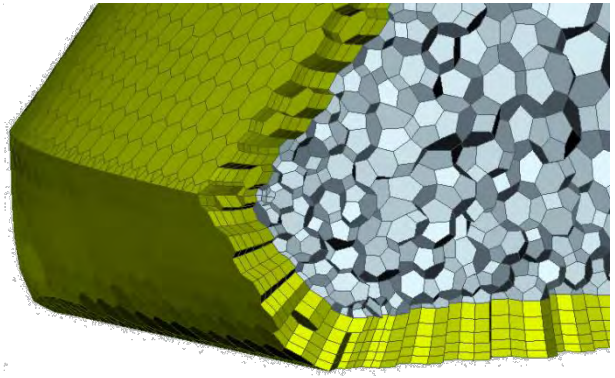


Polyhedral conversion options

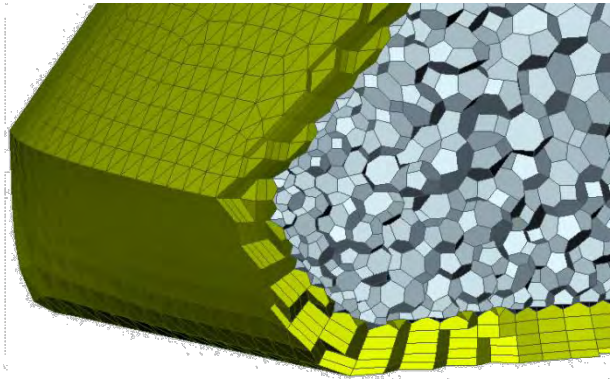
Converted HexaInterior mesh

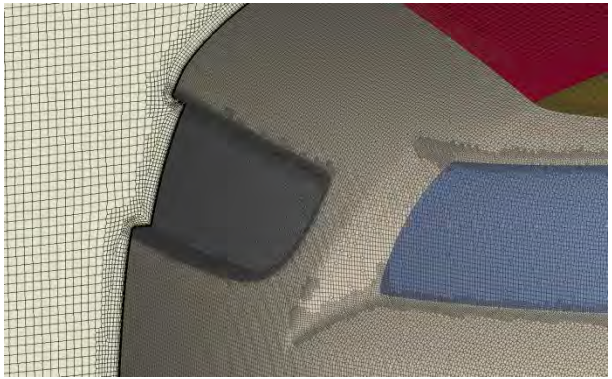


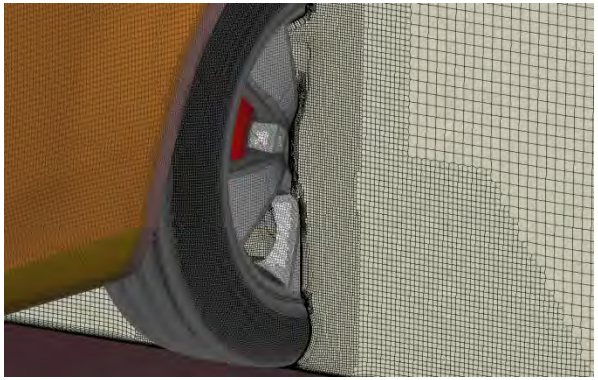
Converted tetra and layers

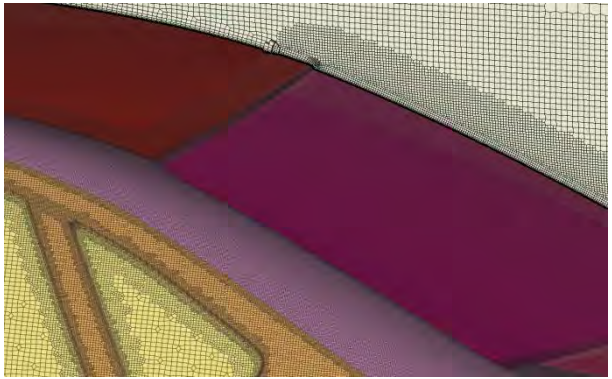


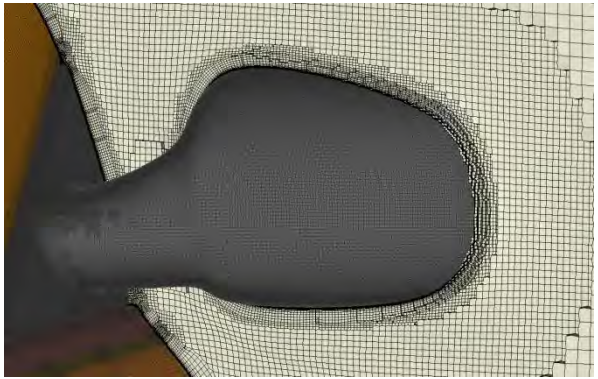
Layers excluded from conversion





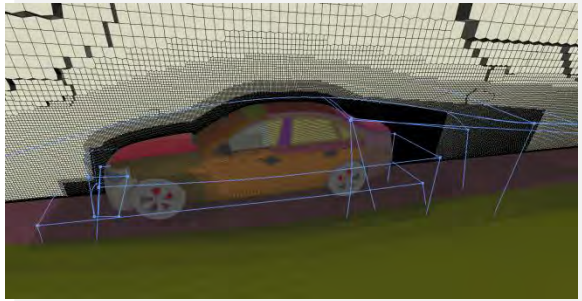




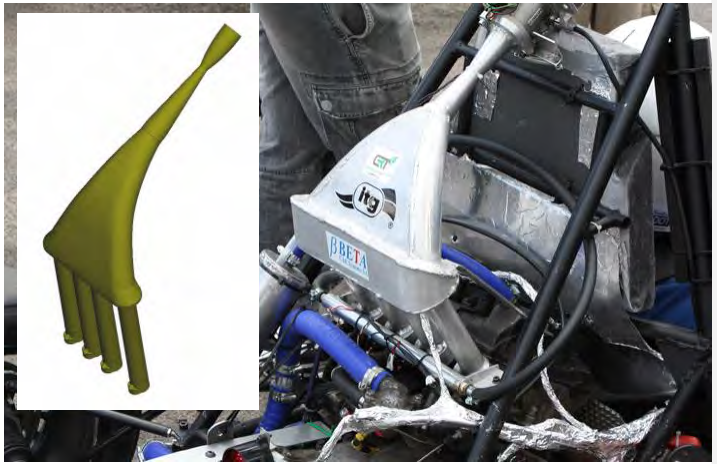


Hextreme volume meshing

Fully automated, highly controllable, trim hexa and polyhedral mesh generation without the need for watertight volume definitions, running on multi core hardware



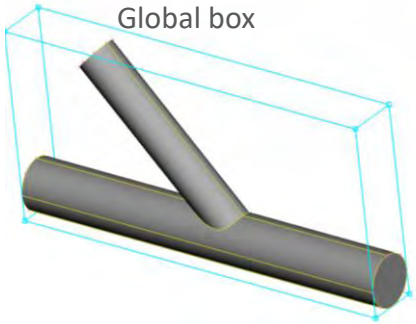
Semi-automatic hexa/penta meshing



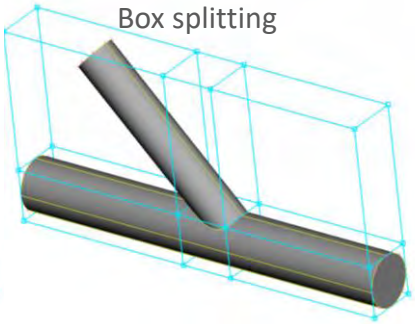
HexaBlock meshing

Hexa meshing based on block structures associated to the model

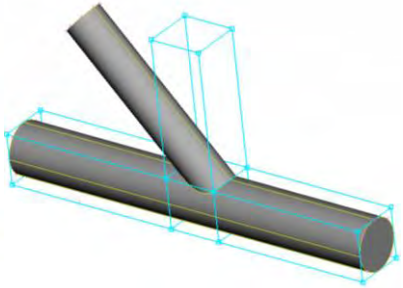
Global box



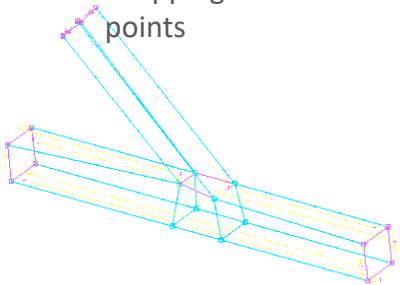
Box splitting



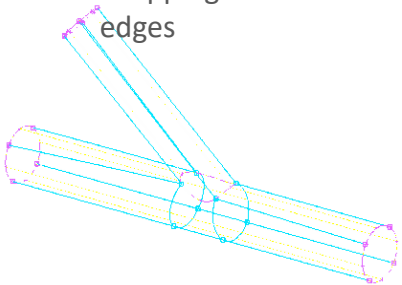
Deletion of unneeded boxes



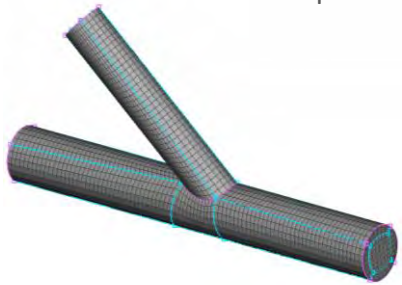
Snapping of points



Snapping of edges

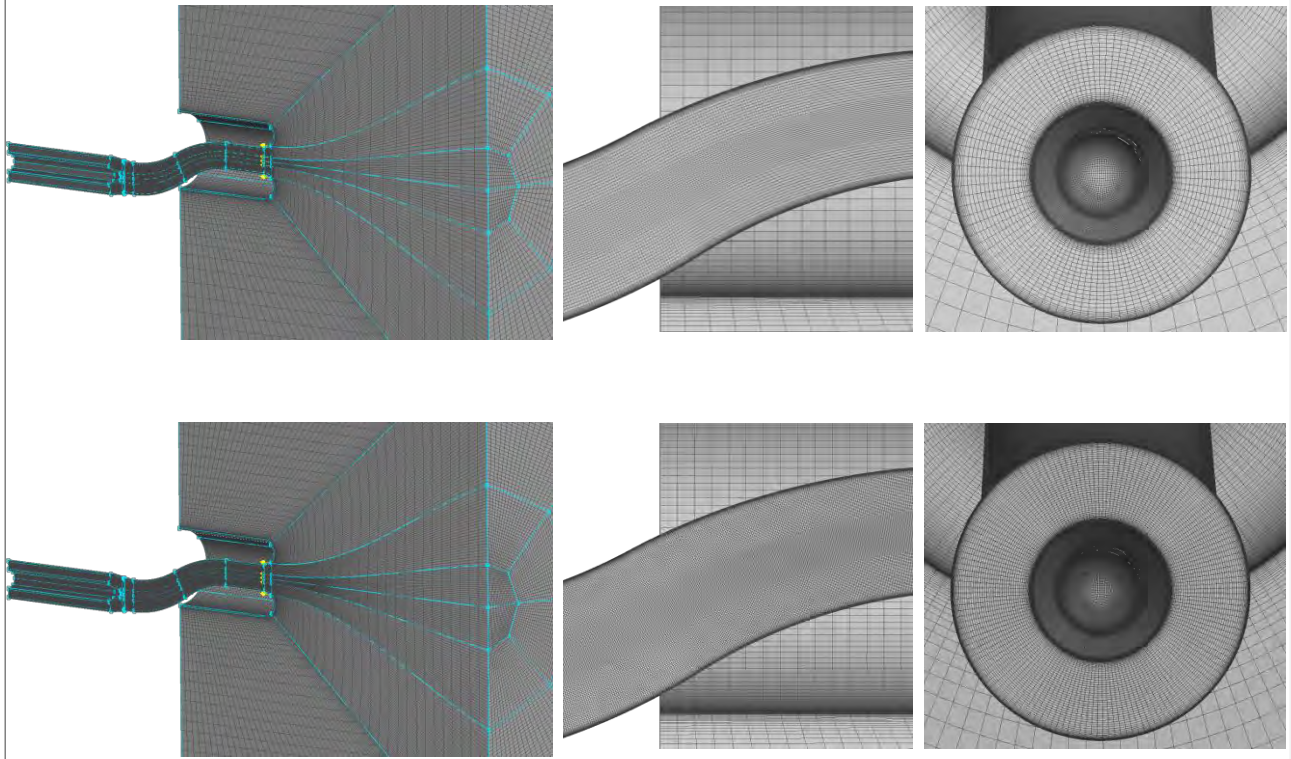


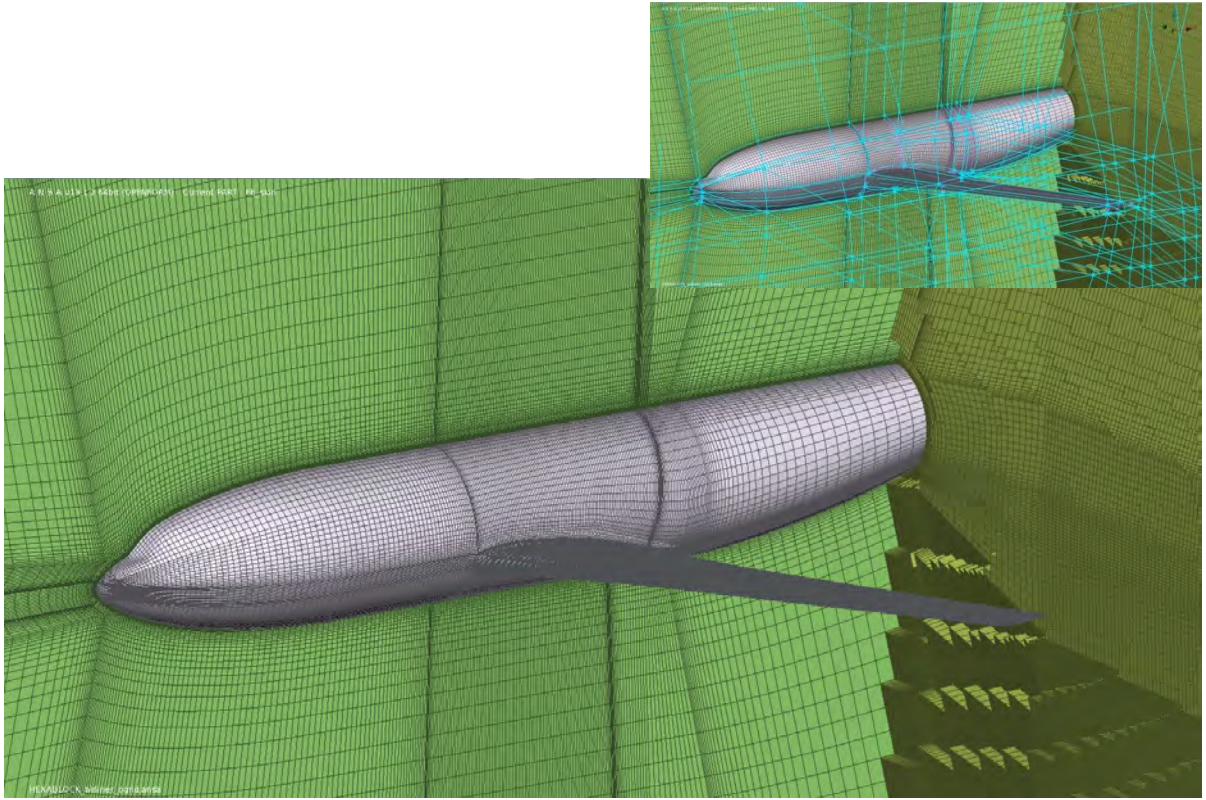
Hexa mesh with O-GRID patterns



HexaBlock meshing

Numerical simulation of flow through S-duct - 1st Propulsion Aerodynamics Workshop



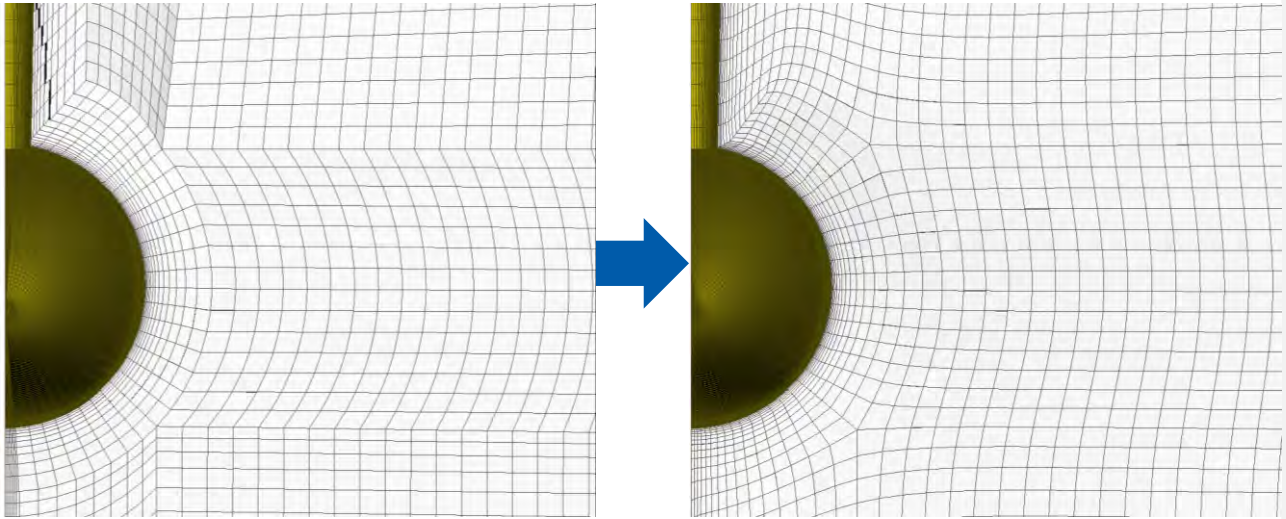


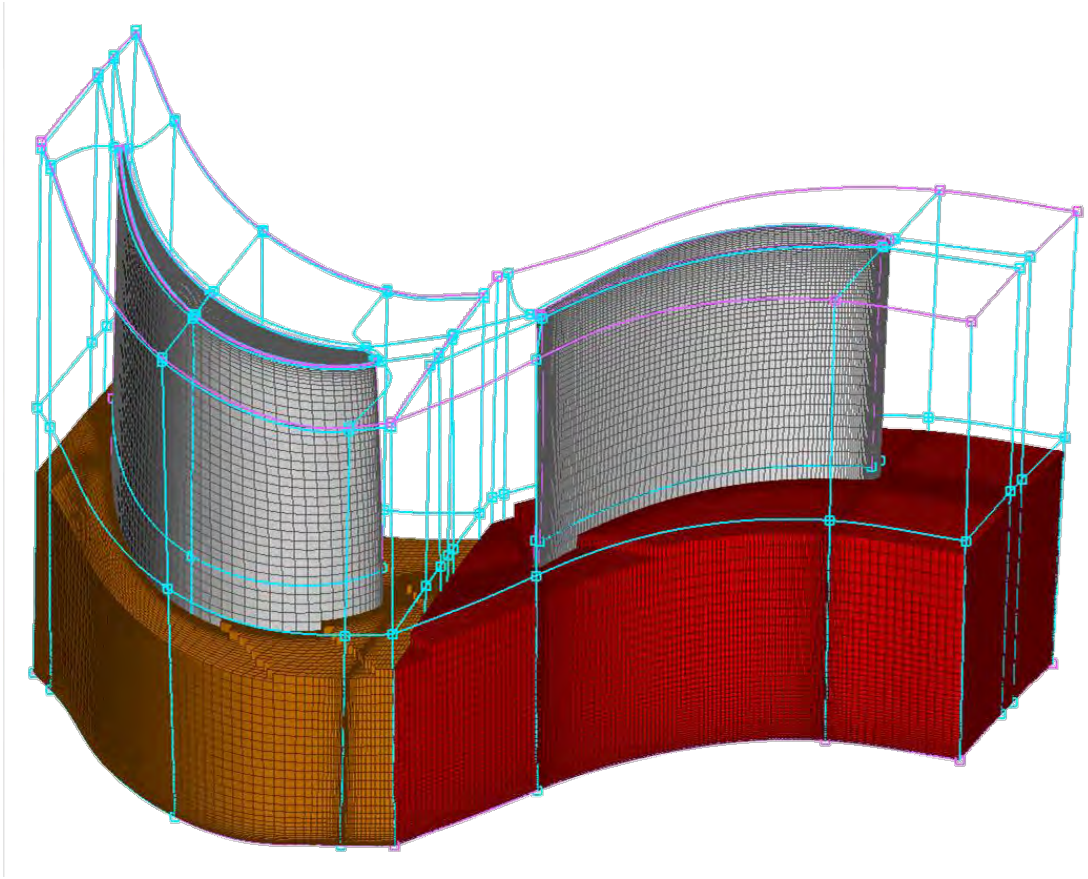
HexaBlock meshing

Hexa meshing external flows

HexaBlock meshing

Advanced smoothing algorithm with imposed orthogonality near the walls



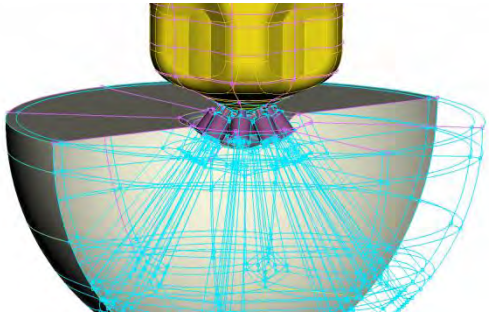


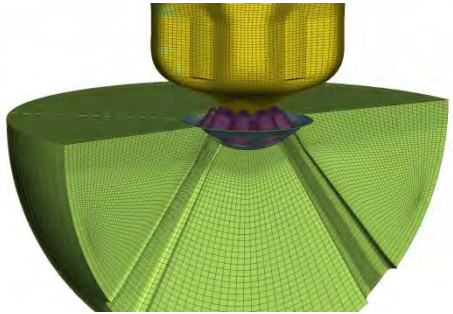
HexaBlock meshing

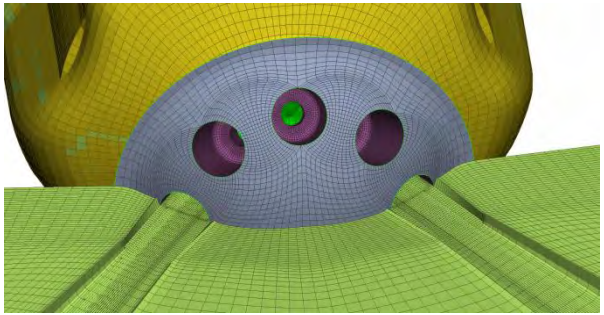
Automatic template driven hexa meshing for turbomachinery applications

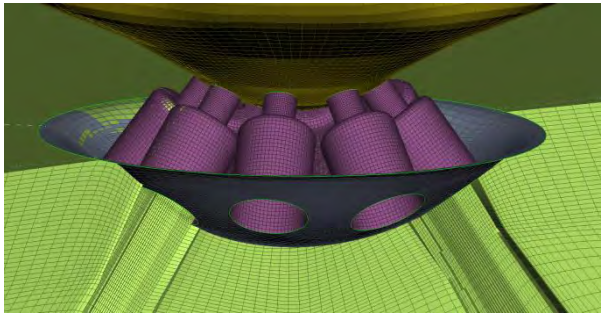
HexaBlock meshing

Fuel injector

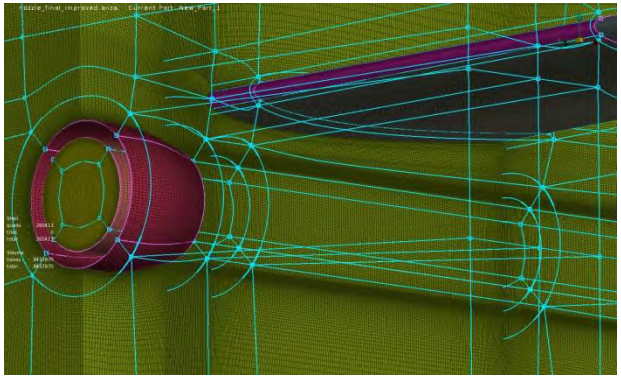


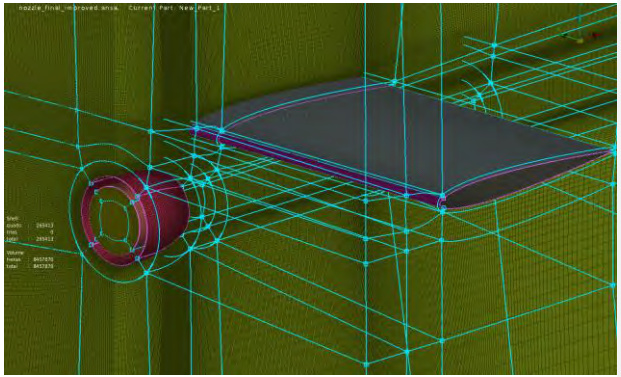






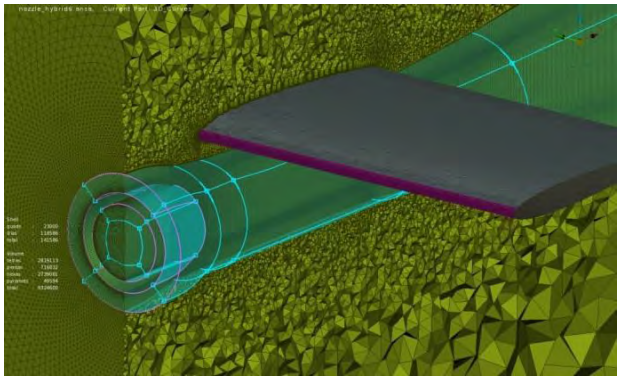
Pure Hexa Mesh

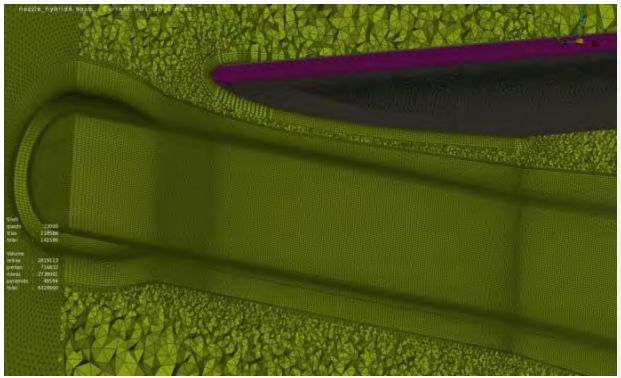


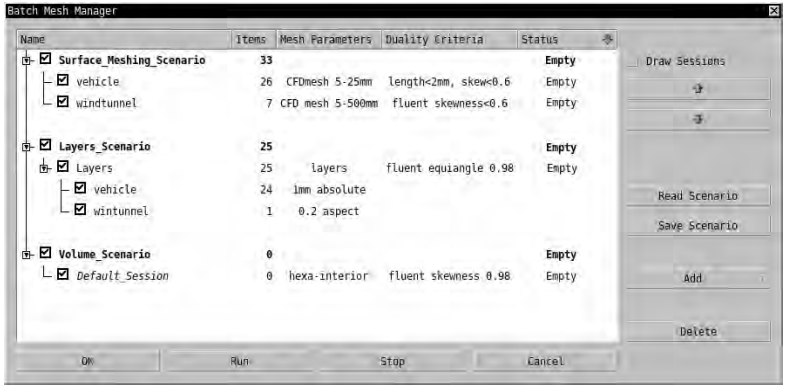


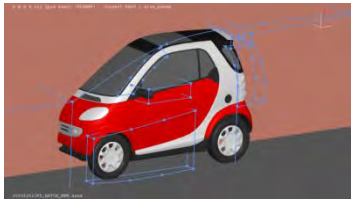
HexaBlock meshing of generic jet exhaust under wing

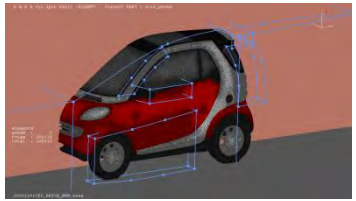
Combination of hexa mesh with hybrid mesh

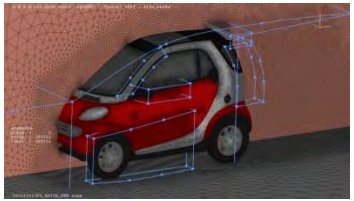


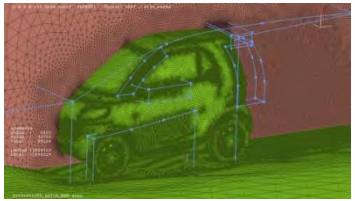


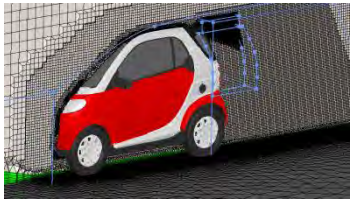








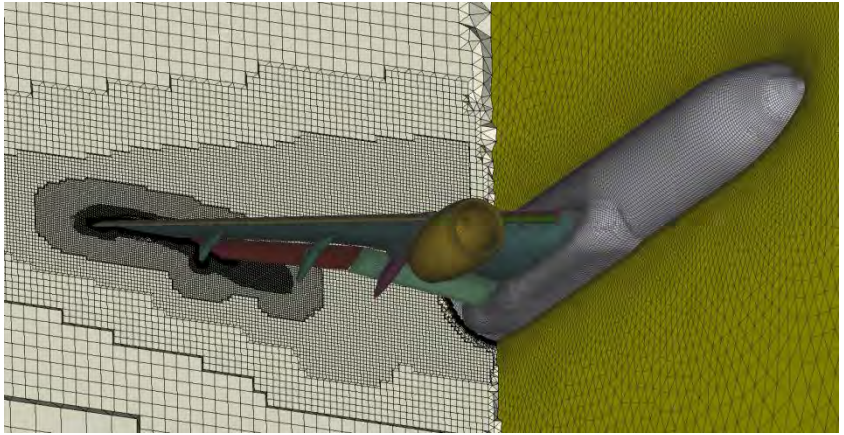


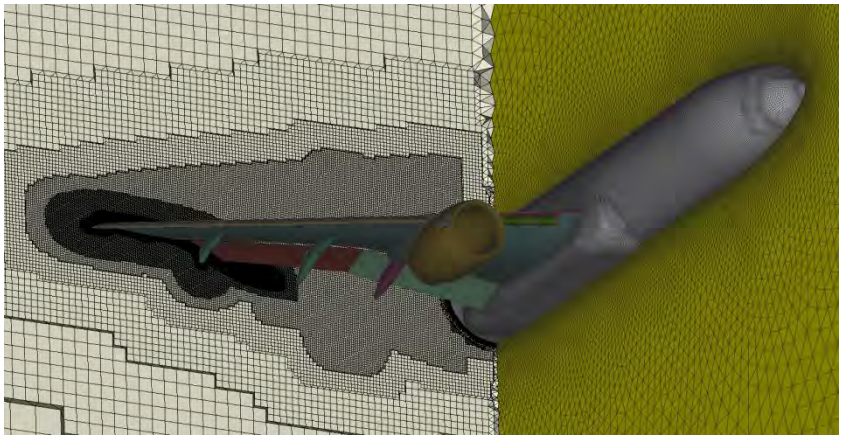


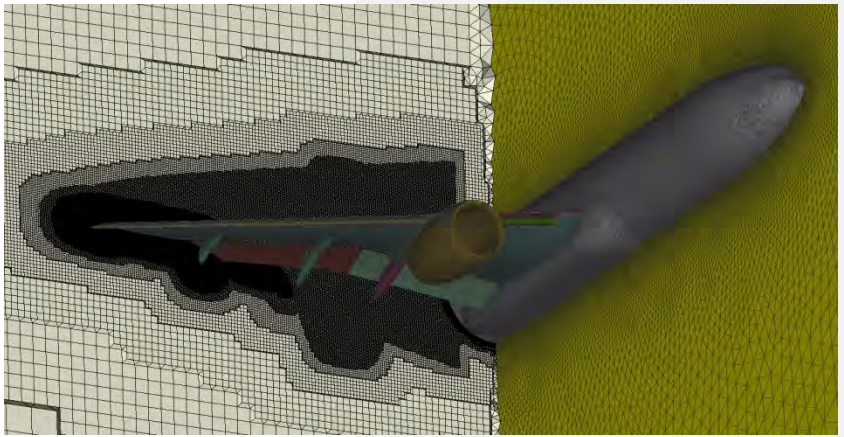
Batch Meshing tool for complete CFD mesh generation

Batch Mesh provides:

- Automation
- Consistency
- Mesh specs traceability





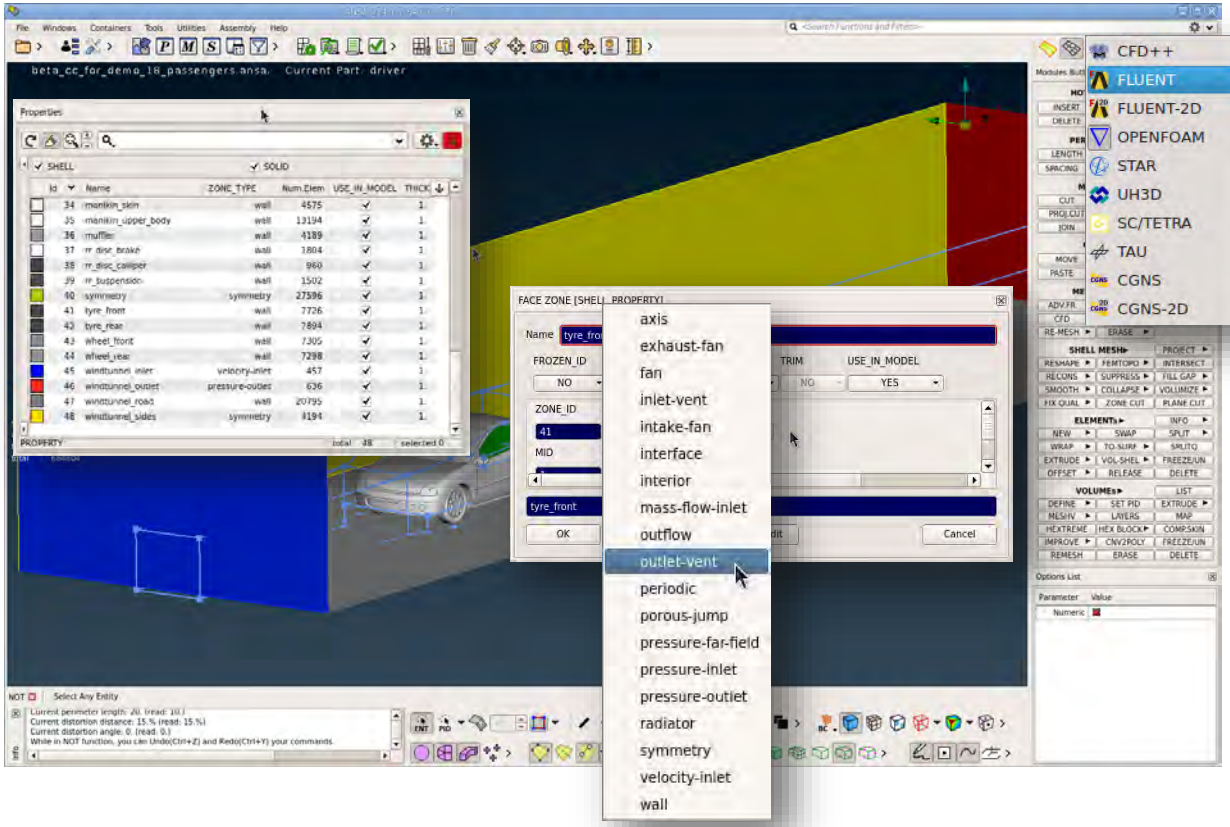


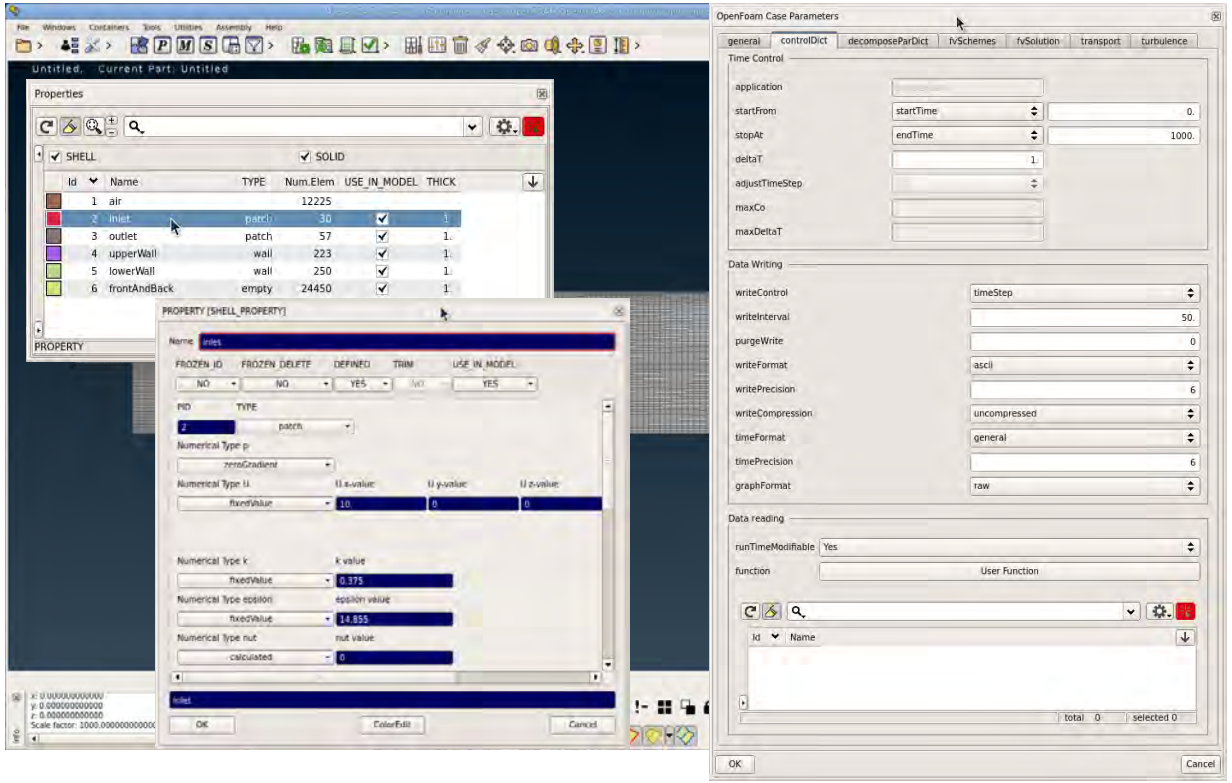
Automated mesh refinement study HLPW 4 model

Level A: 91 million
Level C: 276 million
Level E: 723 million

Output solver files

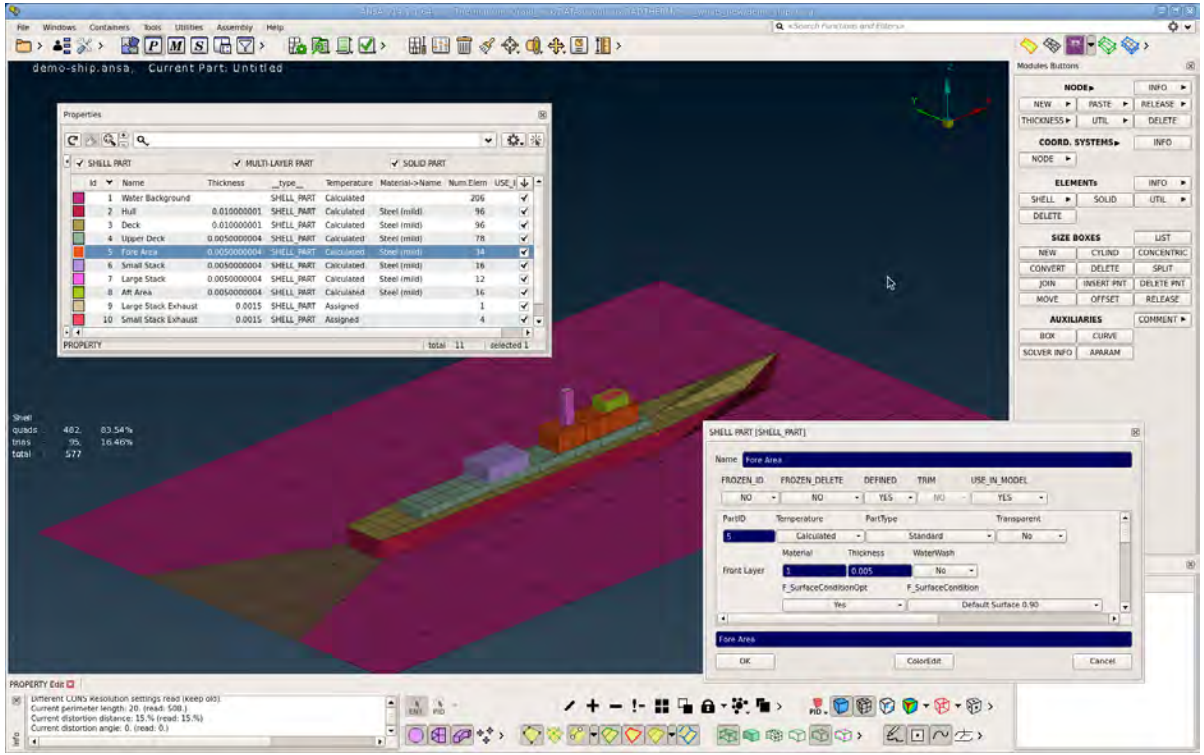
Boundary condition type specification for various CFD solvers





Full support of OpenFOAM mesh and case setup

Boundary conditions, porous and MRF zones, turbulence models, controlDict support, integrated checkMesh and more

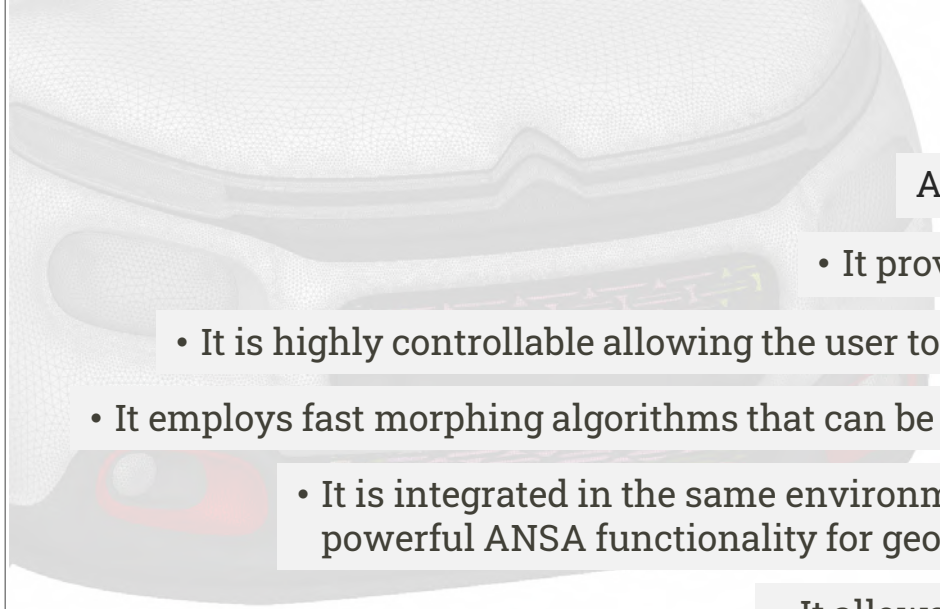


Thermal management support for TAITherm and THESEUS-FE

Direct I/O of native *.tdf files (TAITherm) and *.tfe files (THESEUS-FE)
Support of shell and solid mesh, Parts (single and multilayer) and Assemblies, Materials, Boundary conditions and main solver settings

Morphing

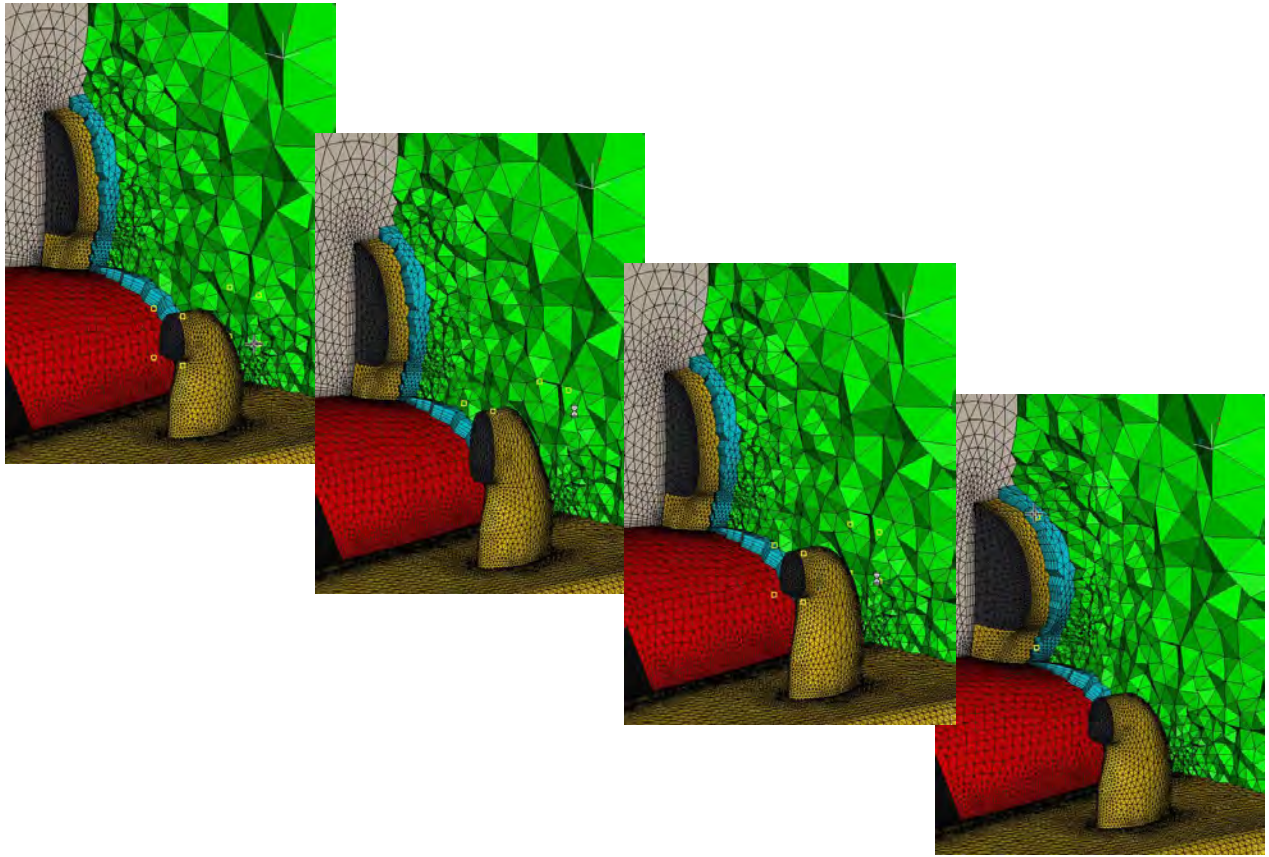
Geometry handling
Meshing
Volume meshing
Output solver files
Morphing
Script language
Other tools
ANSA
PRE PROCESSOR



ANSA Morphing

ANSA morphing tool has the following advantages:

- It provides flexible parameterization of your CFD model
- It is highly controllable allowing the user to perform the exact modifications that are required
- It employs fast morphing algorithms that can be used efficiently and robustly on large CFD models
- It is integrated in the same environment so that it can be used in conjunction with the powerful ANSA functionality for geometry handling and surface and volume meshing
- It allows scaling and history tracking of morphing actions
- It is applicable to surface & volume mesh and geometry
- Morphing can be performed interactively or in pure batch mode, also coupled with optimizer software
- It can be used with direct interfaces with all major CFD codes, like Fluent, Star CCM+, and OpenFOAM among others

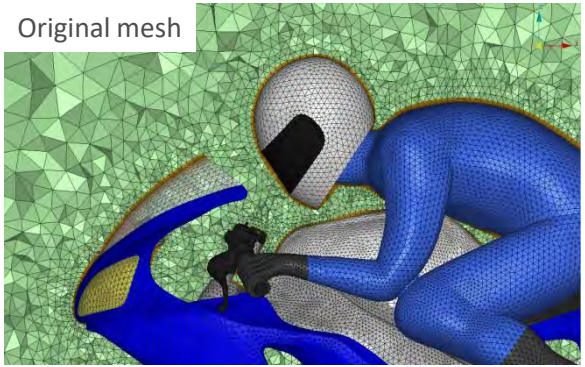


Morphing

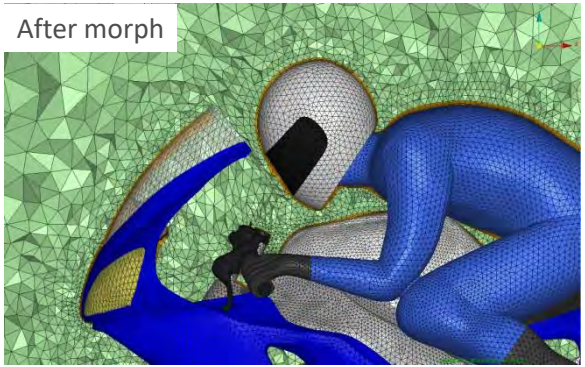
Morphing of shell and volume mesh by user-interaction, or in batch mode accelerates engineering development

Morphing for external aero

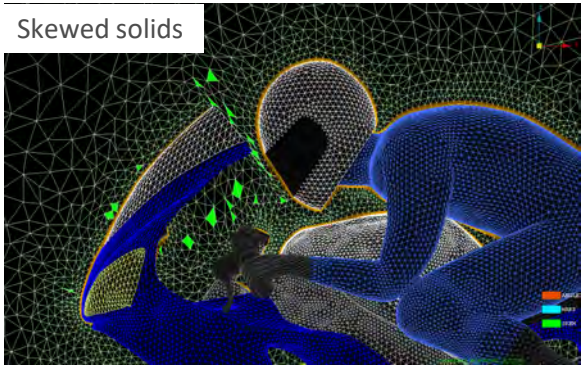
Original mesh



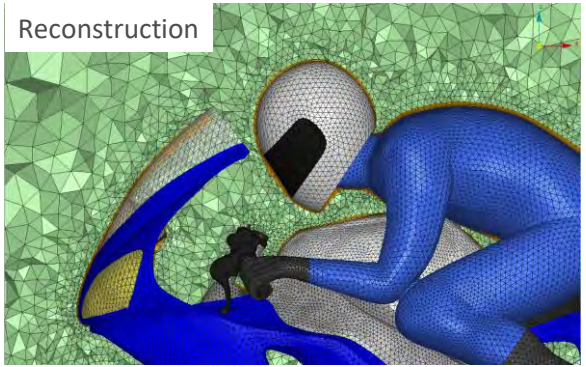
After morph



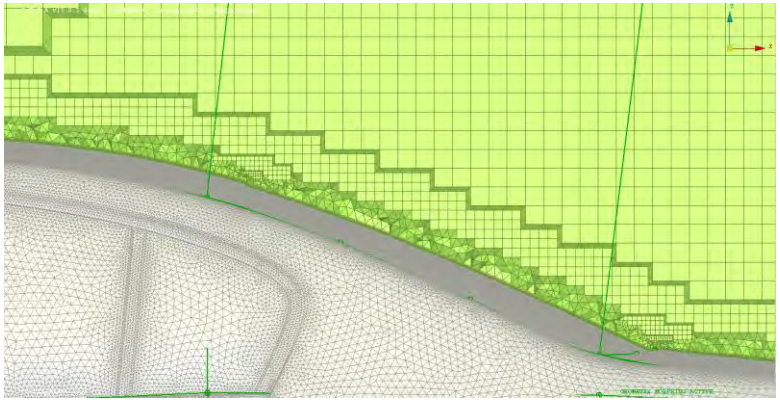
Skewed solids

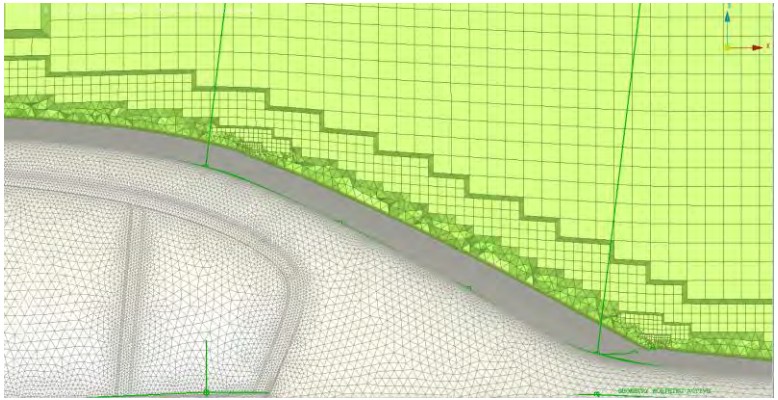


Reconstruction



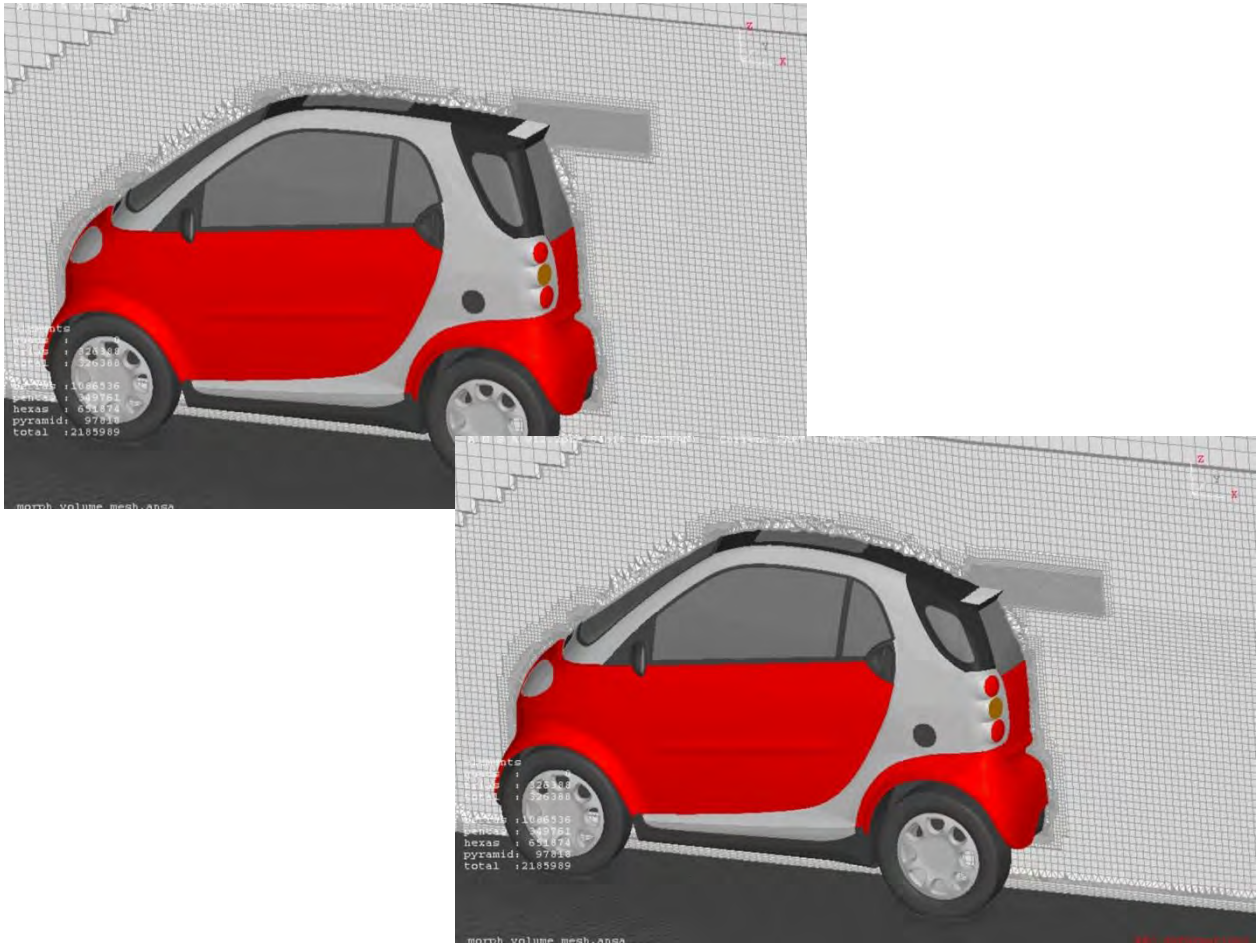
Rear windscreen morphing



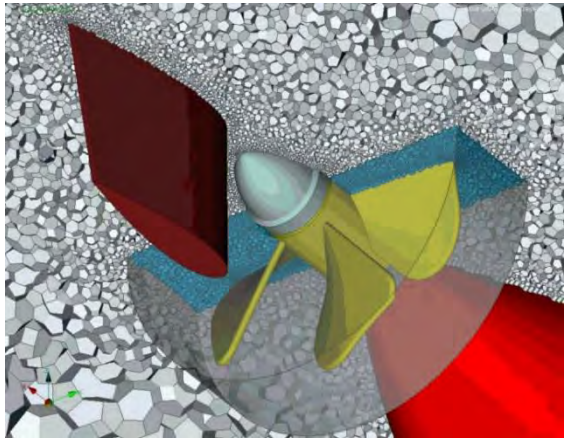


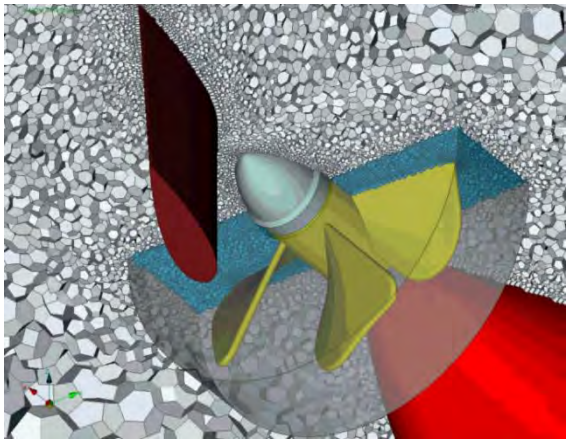
By permission of Volkswagen AG

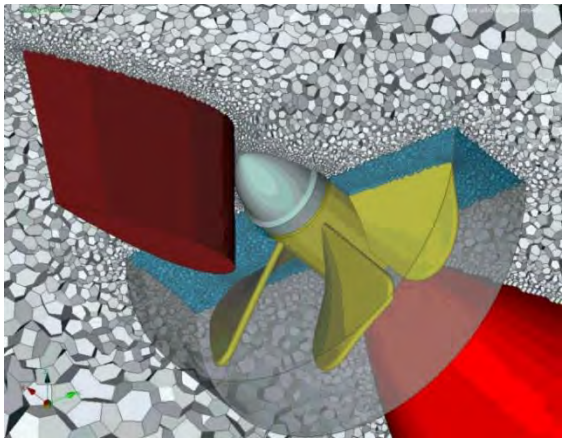
Morphing of rear spoiler



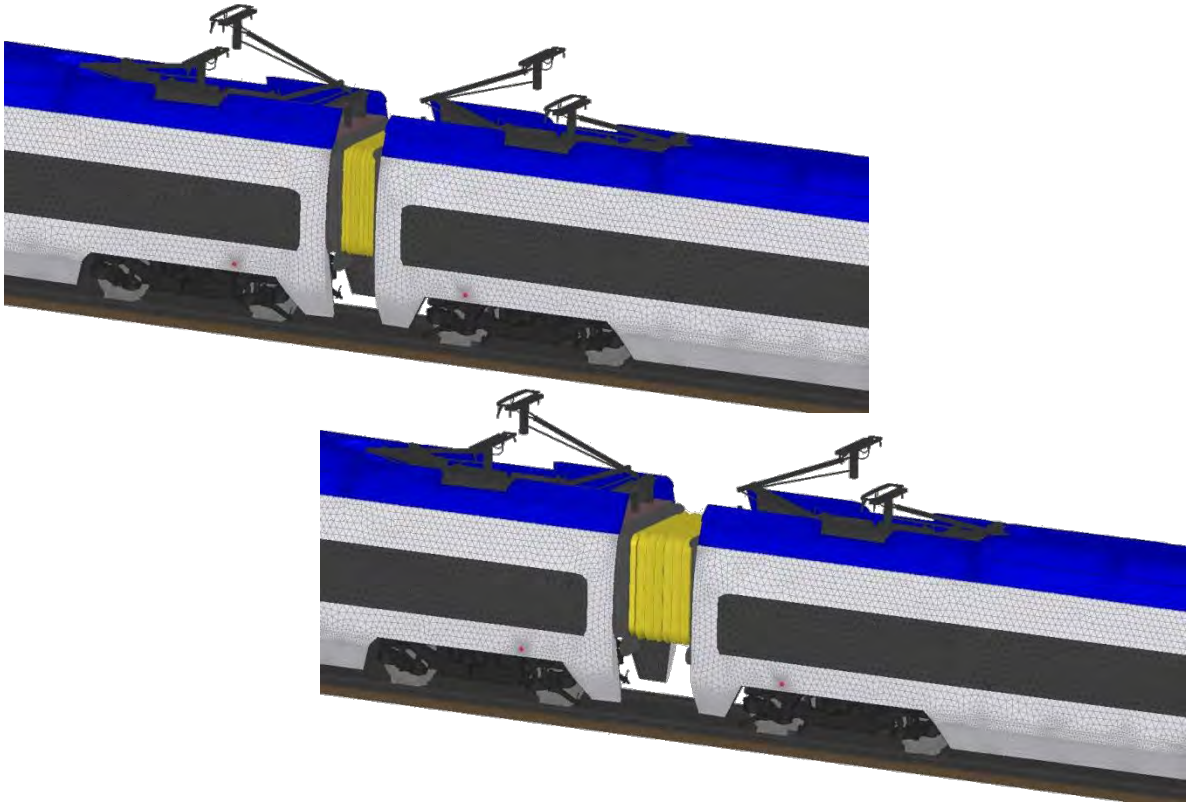
Morphing of ship rudder



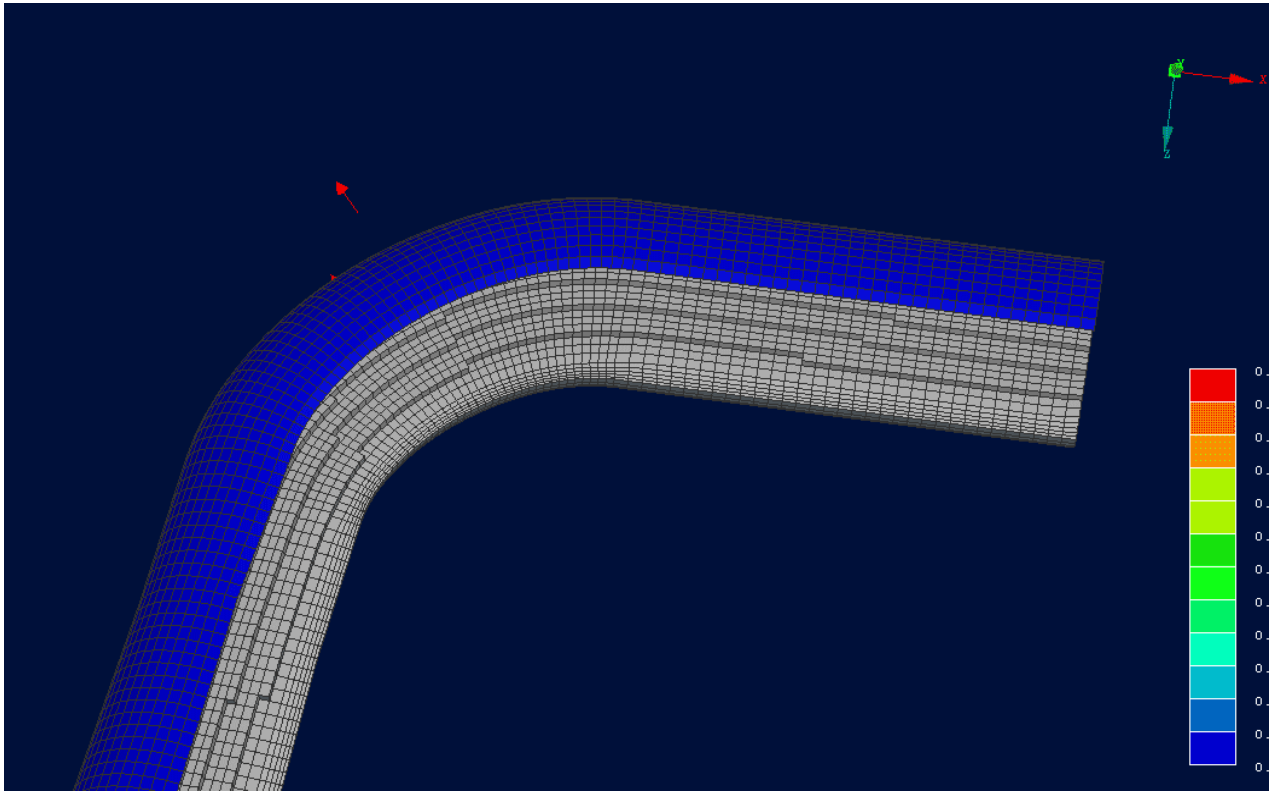


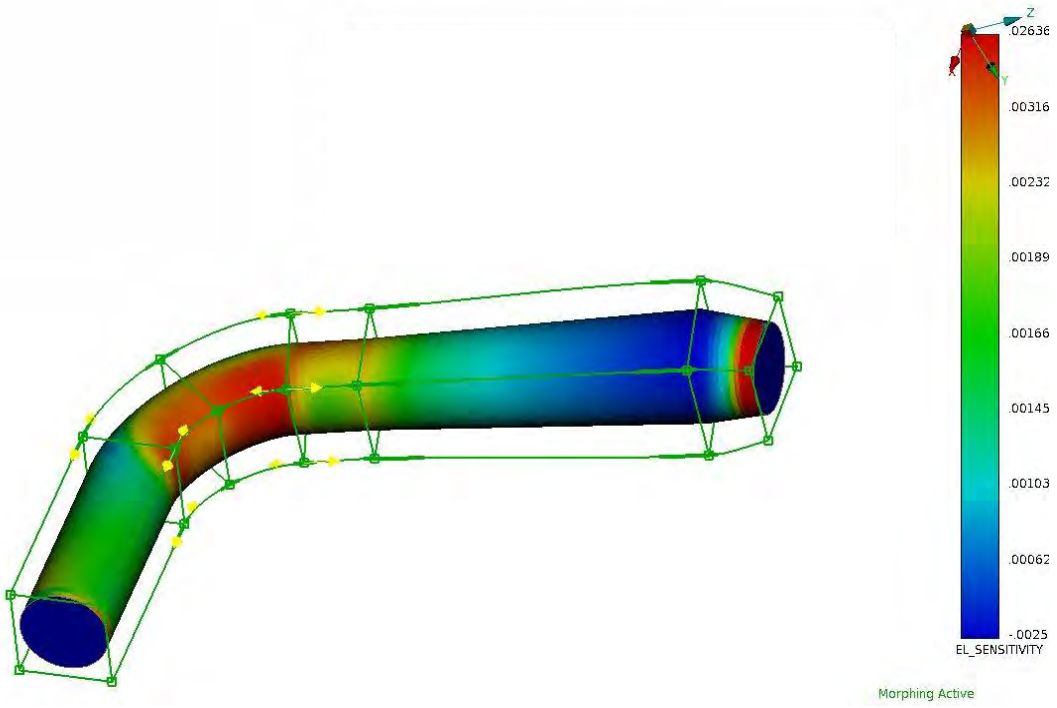


Morphing on train model



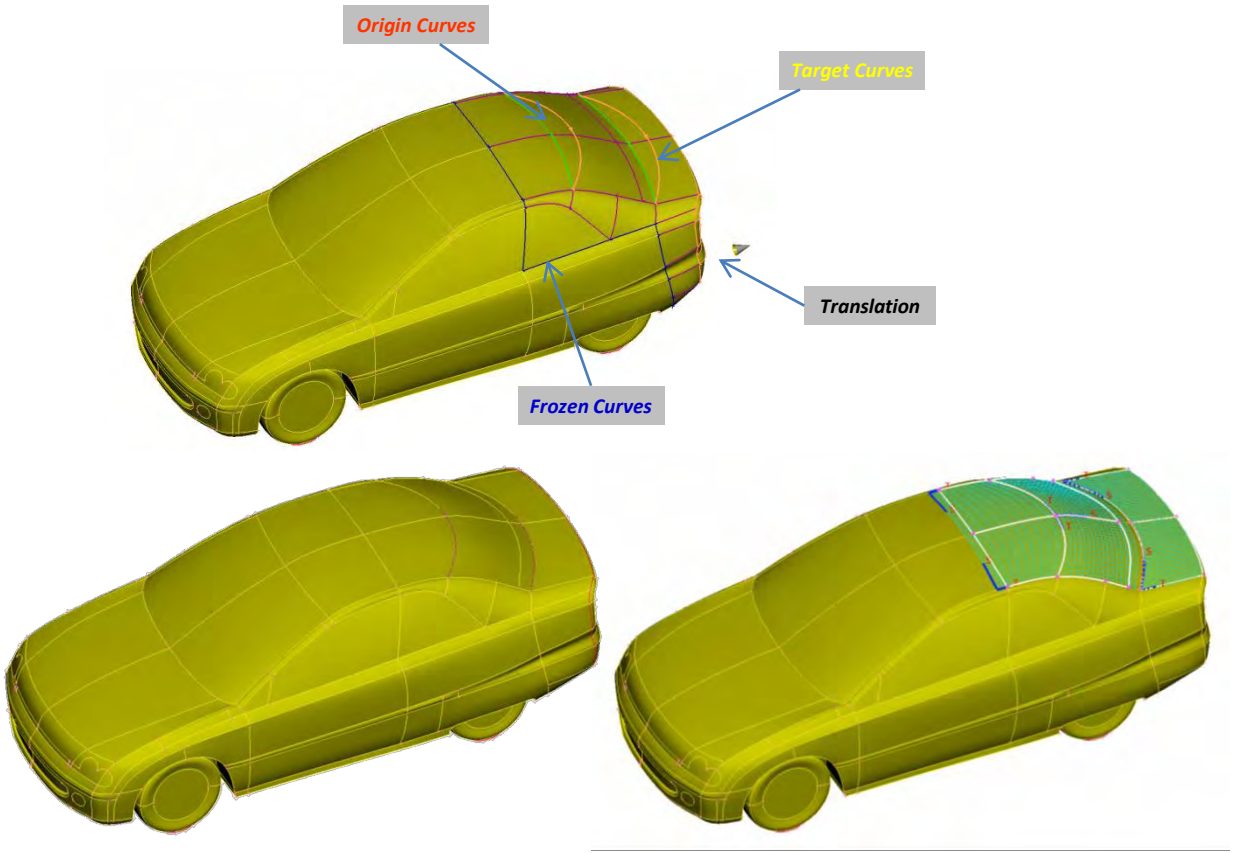
Scalable morphing deformations





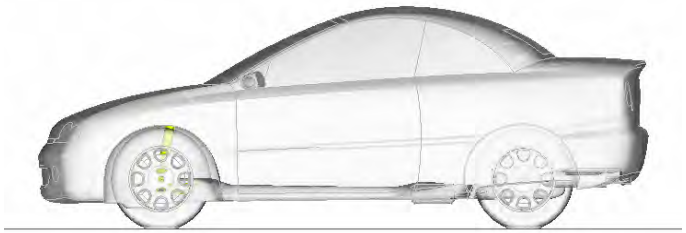
Support of adjoint sensitivity guided morphing

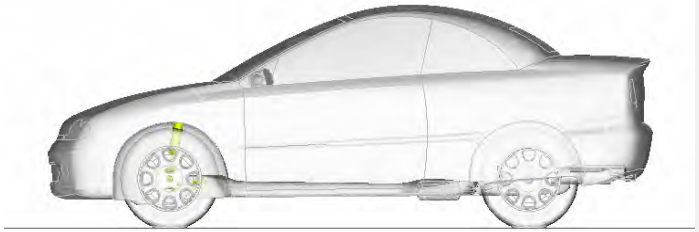
Sensitivity Based optimization with ANSA morphing boxes and parameters that control the motion of morphing points using solver calculated sensitivities



Changing the ride height setup with direct morphing

Positioning of the suspension setup without loosing the watertight integrity and quality of the mesh

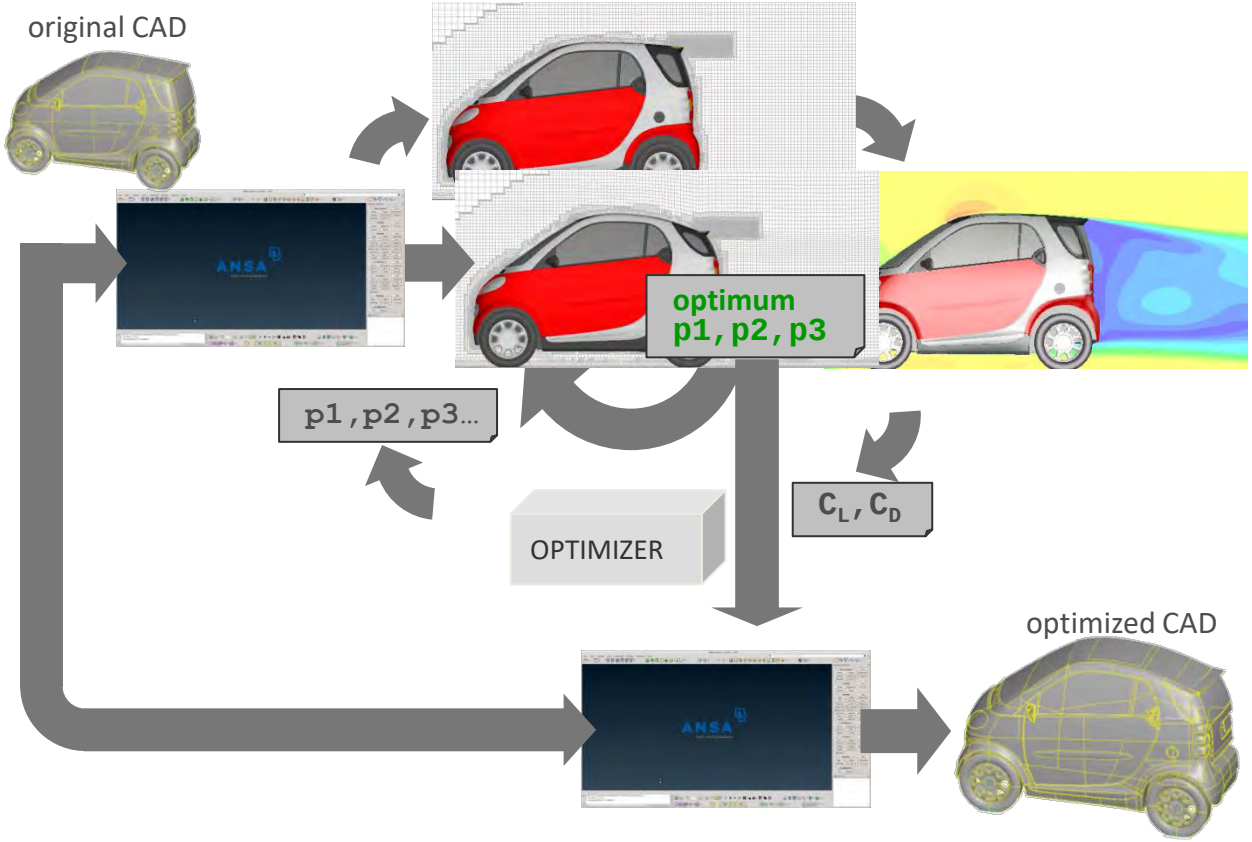




Changing the ride height setup with direct morphing

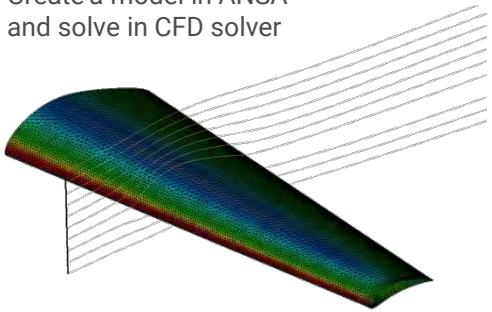
Positioning of the suspension setup without loosing the watertight integrity and quality of the mesh

Morphing optimization loop

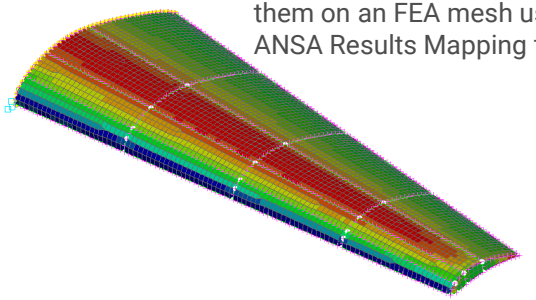


CFD-FEA two way coupling

Create a model in ANSA and solve in CFD solver



Extract the pressures from the CFD solver and map them on an FEA mesh using ANSA Results Mapping tool



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Id,Dispx,Dispy,Dispz,posx,posy,posz
1,0.000E+00,0.000E+00,0.000E+00,2.668E+01,-7.650E-05,4.030E+01
2,1.947E-01,1.373E-01,7.191E+00,1.033E+02,-7.499E+02,4.637E+01
2,1.947E-01,1.373E-01,7.191E+00,1.033E+02,-7.499E+02,4.637E+01
3,3.121E-01,-1.953E-03,1.112E+01,7.755E+01,-1.000E+03,4.157E+01
3,3.121E-01,-1.953E-03,1.112E+01,7.755E+01,-1.000E+03,4.157E+01
3,3.121E-01,-1.953E-03,1.112E+01,7.755E+01,-1.000E+03,4.157E+01
4,3.487E-01,-1.965E-01,1.102E+01,4.613E+01,-1.000E+03,3.005E+01
5,3.450E-01,-1.737E-01,1.105E+01,5.671E+01,-1.000E+03,3.120E+01
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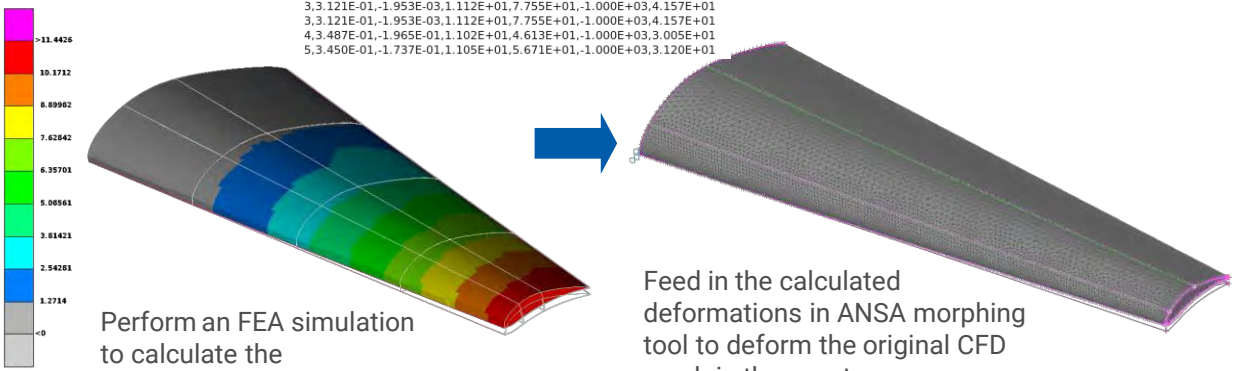
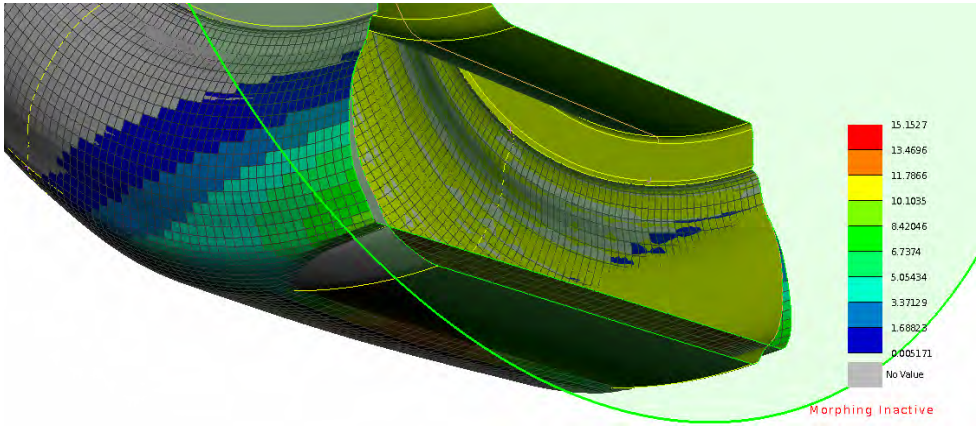
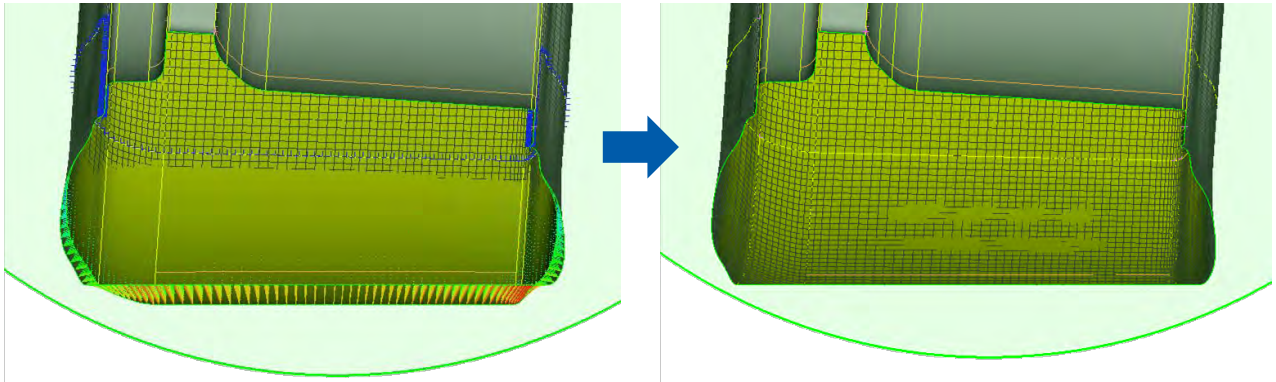


Perform an FEA simulation to calculate the deformations

Feed in the calculated deformations in ANSA morphing tool to deform the original CFD mesh in the exact same manner

Applying FEA deformations on the CFD mesh of the tyre contact patch

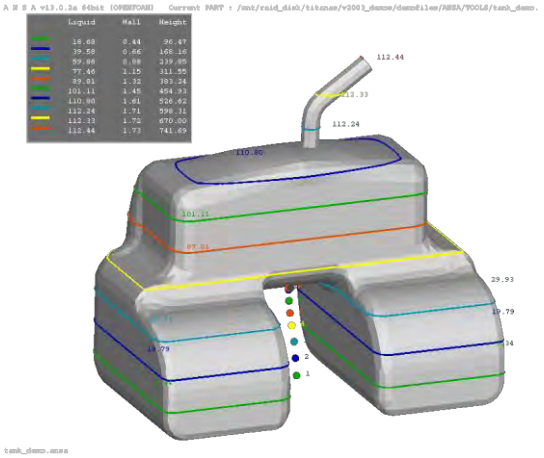


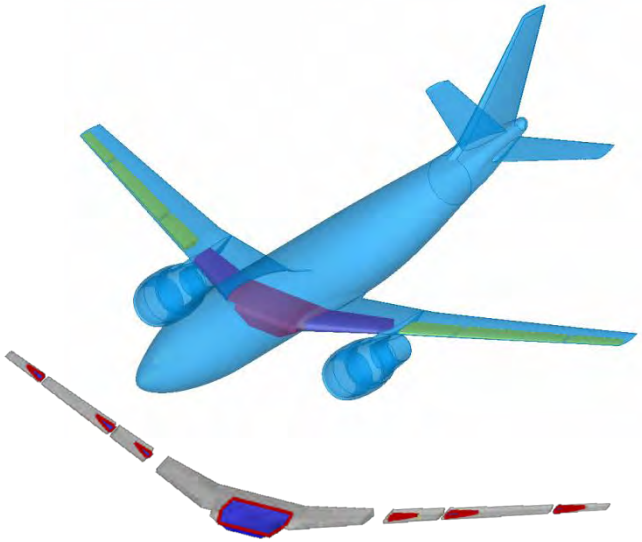


Liquid level calculations

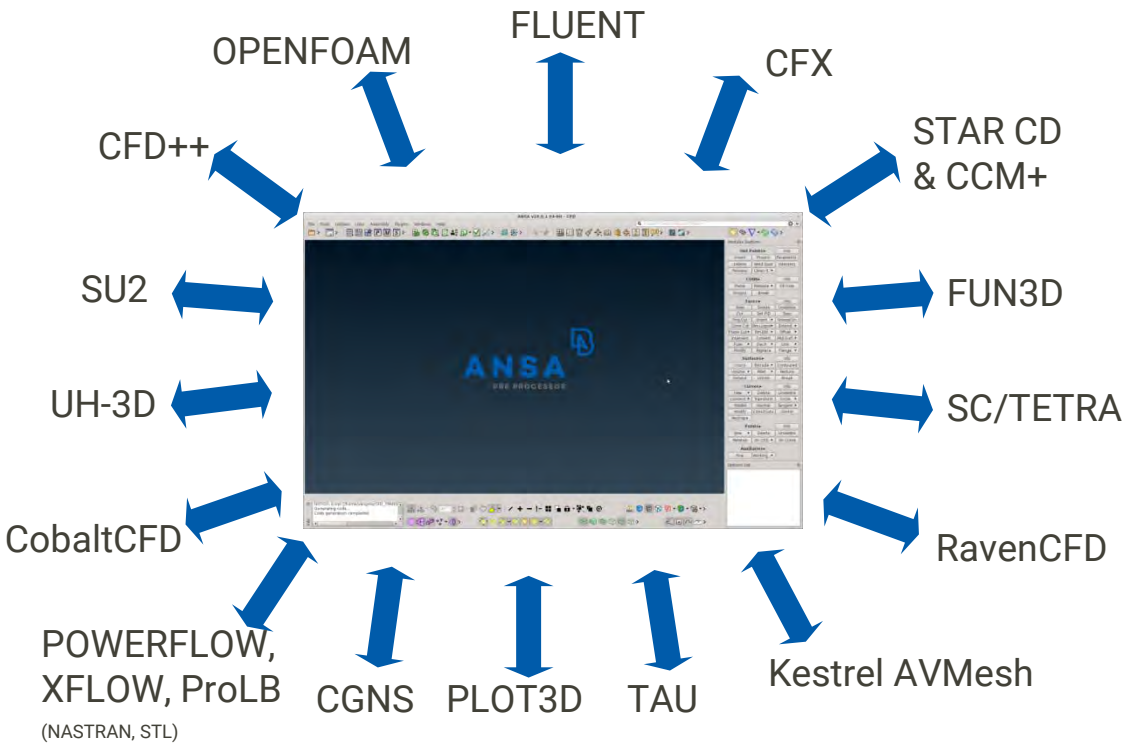
Fuel and resting liquid calculations

Calculation of liquid volume, levels and centre of gravity for various tank configurations and positions





Unused liquid traps



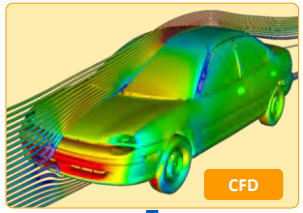
One common pre-processing platform for all CFD solvers

- CMSoft AERO-F via scripting
- NASTRAN, ABAQUS, ANSYS, TAITherm, THESEUS-FE and more…

Post- processing

META

POST PROCESSOR



From solver results to report

- 3D post processing
- 2D post processing
- User calculations
- Correlation studies
- Reporting
- Automation tools

META

An advanced CAE post-processing tool for FEA and CFD analysis

Basic concepts and features:

- Powerful tools for 3D & 2D Post Processing
- High performance graphics
- Low memory footprint
- Best-in-class multi-model handling
- Generation of high-quality reports
- Outstanding automation capabilities

Supported format

ANSYS
- Fluent 2d and 3d standard and HDF5
- CFX
- CFDpost *.cdat

OpenFOAM
- ascii/binary data, partitioned results
- FEMZIP file support

StarCCM+
- *.ccm ,*.sim, *.simh and *.trk files

CFD++

SC/Tetra

SU2

CGNS

DLR-TAU

AVL-FIRE

PowerFlow

Converge

TAITherm

THESEUS- FE

LS-DYNA ICFD

ABAQUS CFD

Ensight

Tecplot

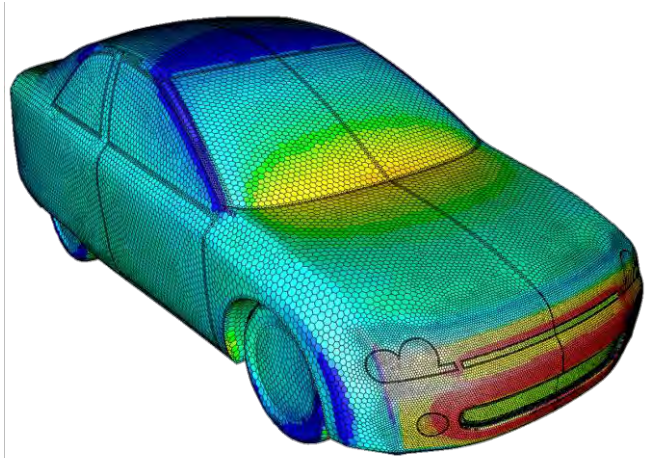
Fieldview

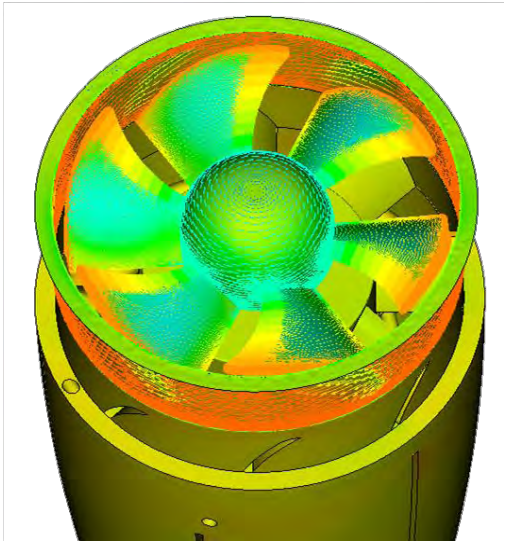
Paraview VTK, VTU, VTP

Plot3D

XDMF

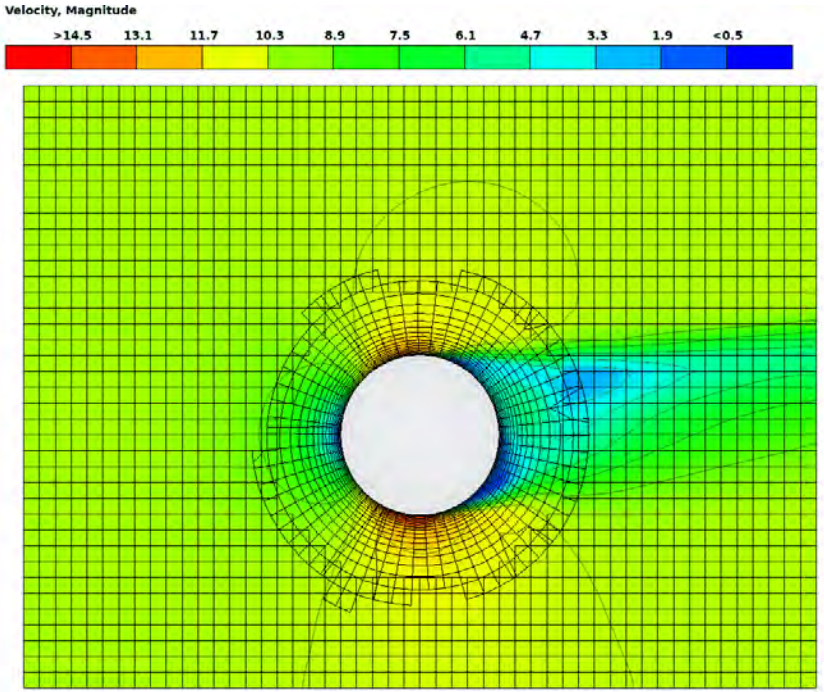
CAD Files
- IGES, STEP, Catia, STL, VRML, Wavefront and more....





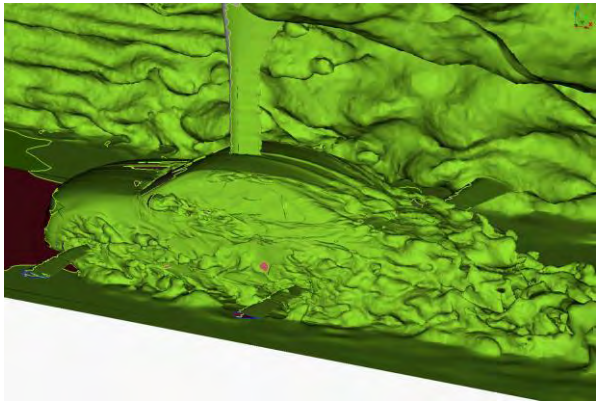
Supported formats

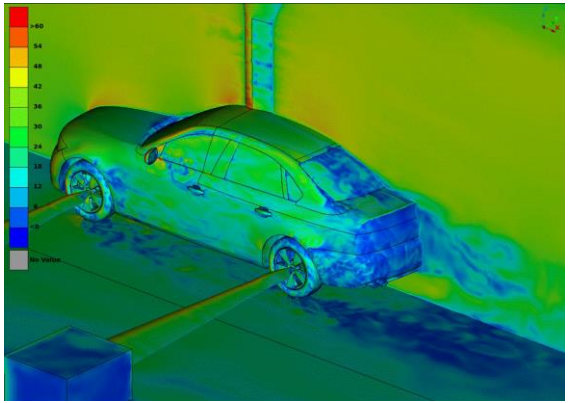
- Standard and Polyhedral elements
- Steady state and transient results
- MRF (multiple reference frame) zones and moving mesh

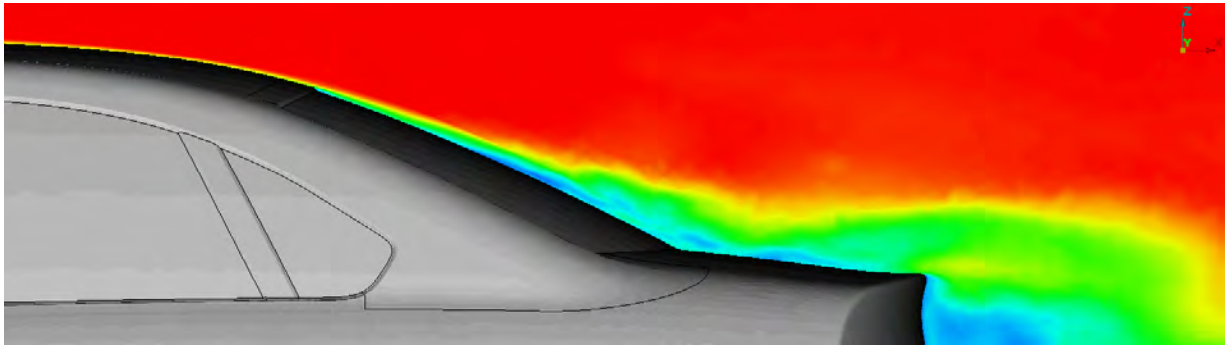


Support of overset meshes for Fluent and StarCCM+

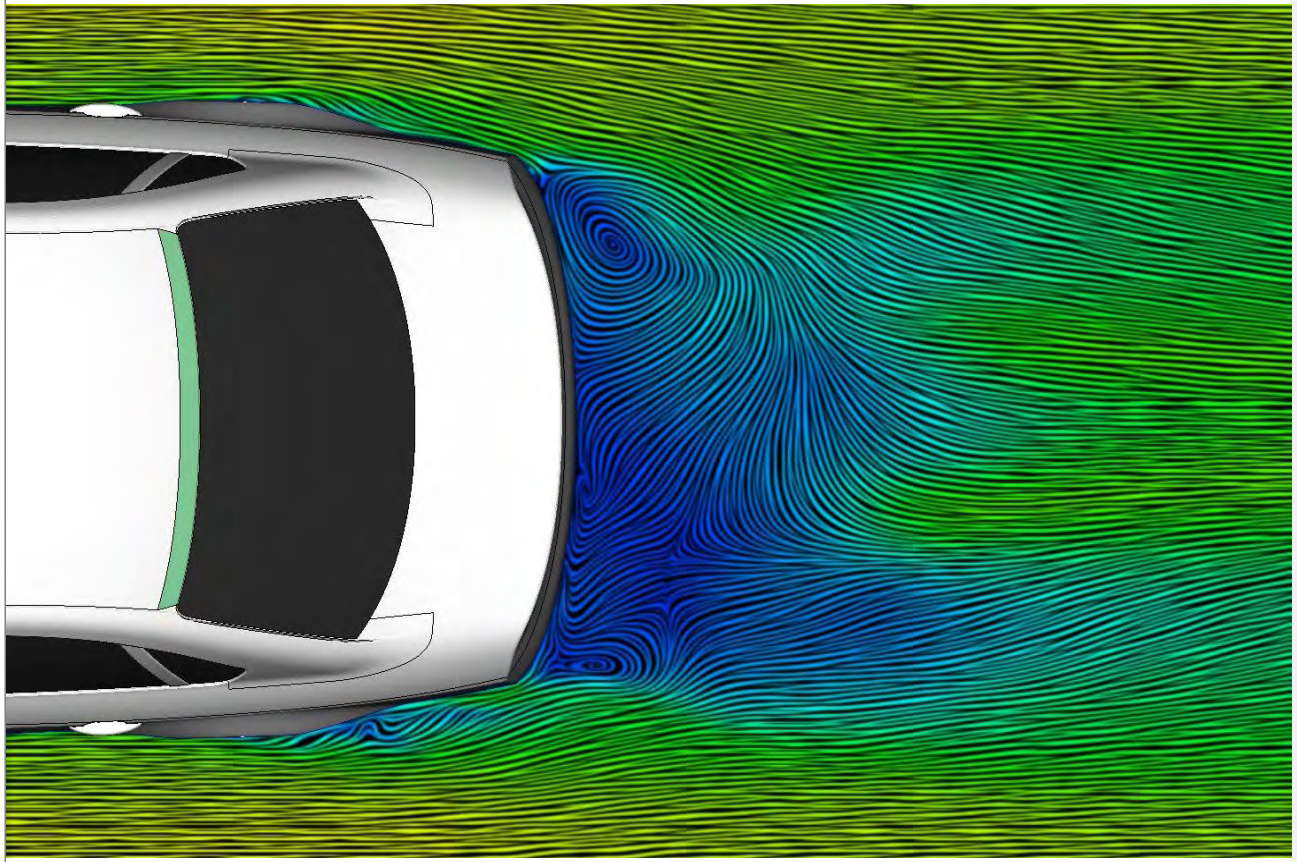
Cut Planes and Iso-Surfaces





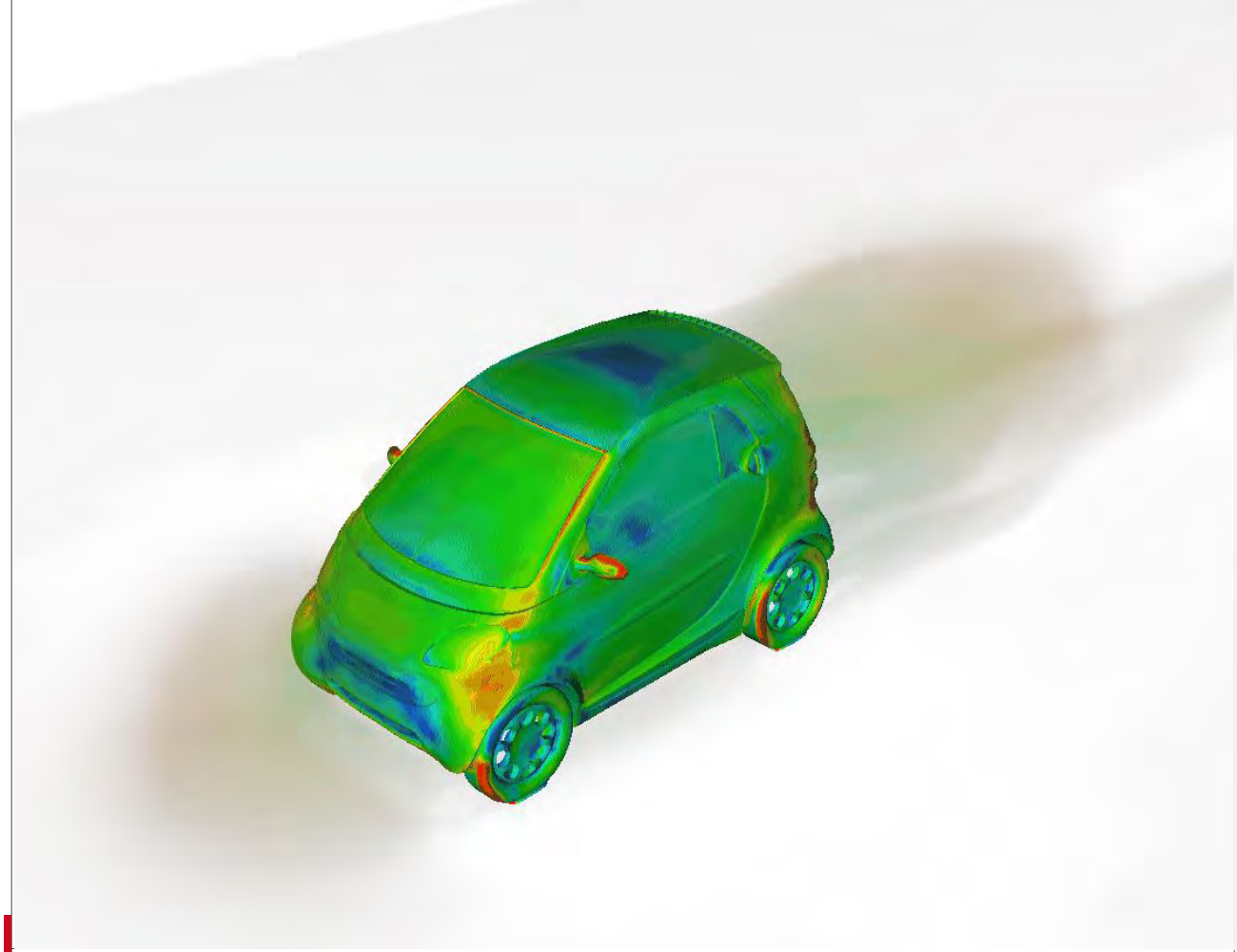


DrivAer model courtesy of Technical University of Munich

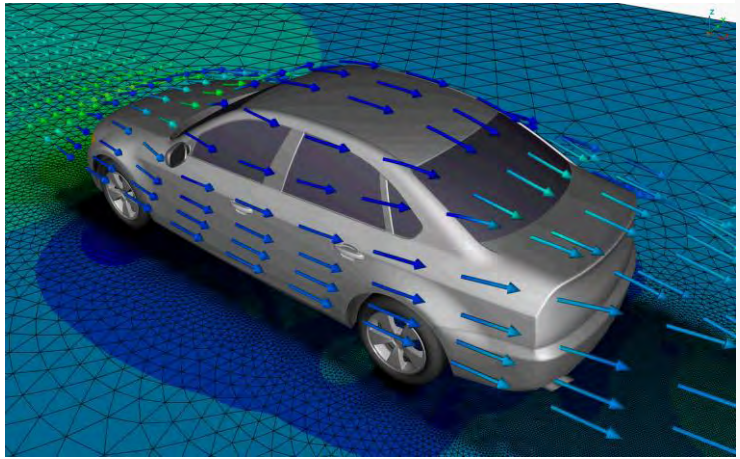


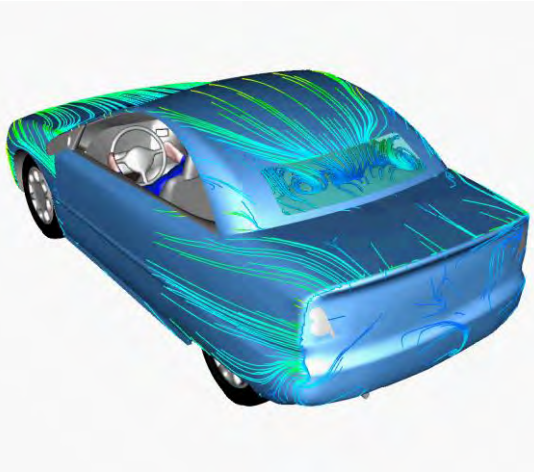
Line Integral Convolution visualization

Volume rendering

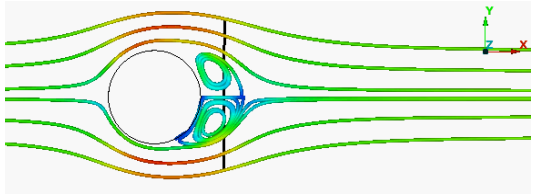


Streamlines and Oil-flow display

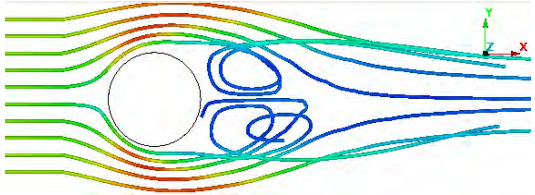




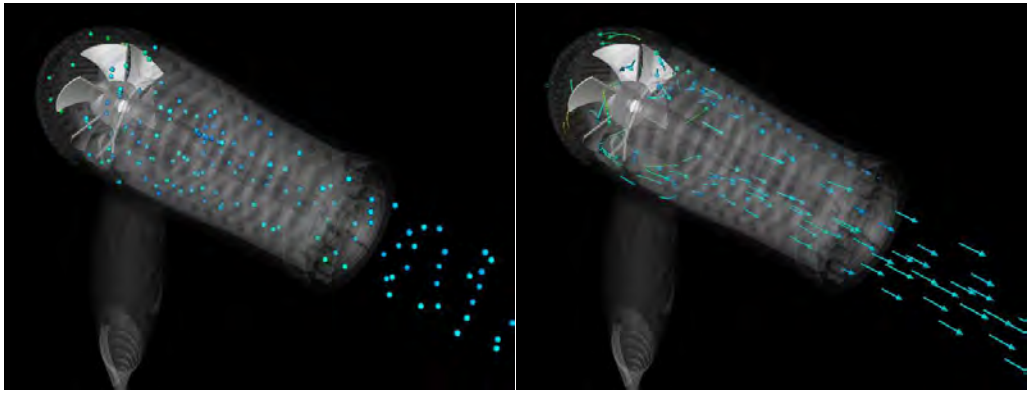
Creation of Streamlines and Pathlines for transient analyses

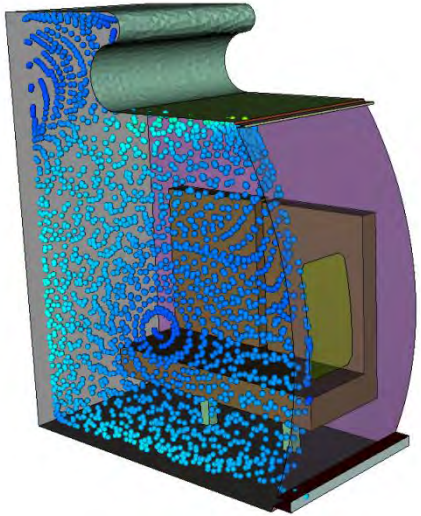


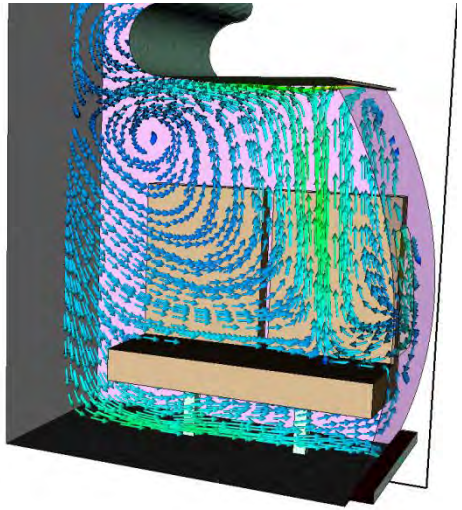
Transient Streamlines



Pathlines



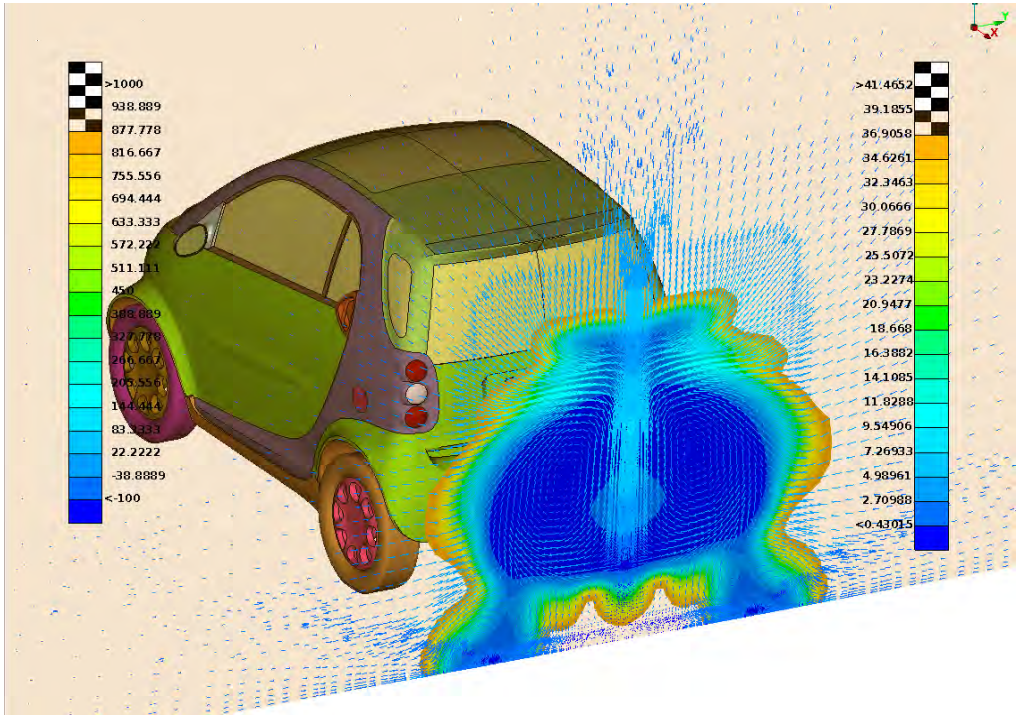




Multiple streamline visualization options

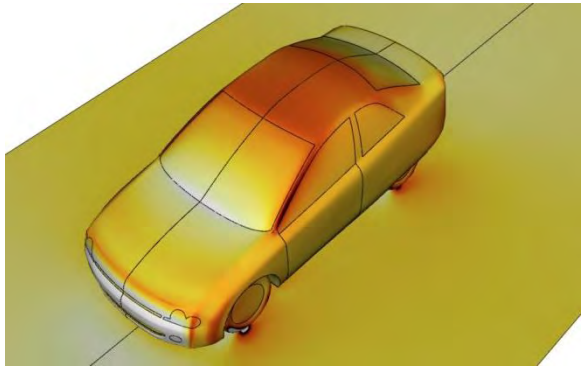
Total pressure contours

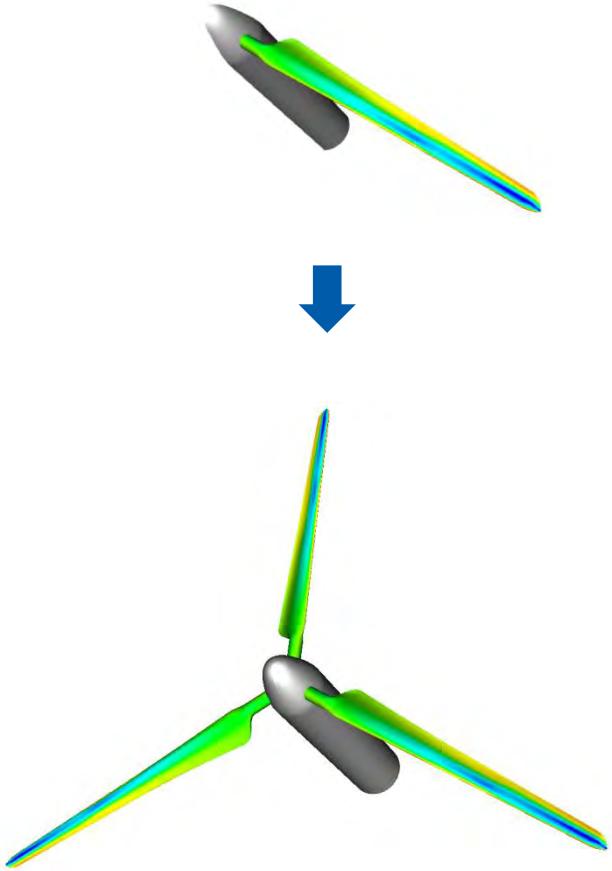
Velocity vectors



Double fringe bars for simultaneous display of contour and vector data

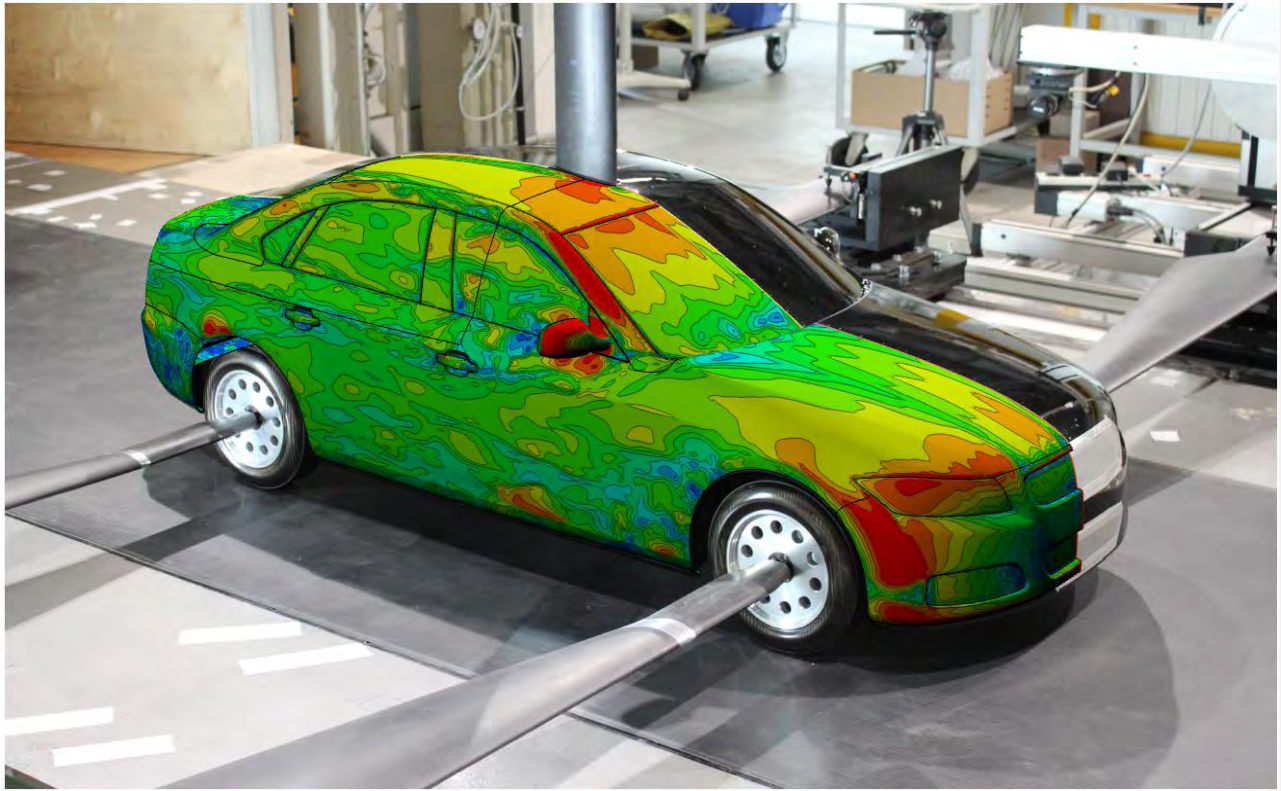
Symmetric and periodic display of results



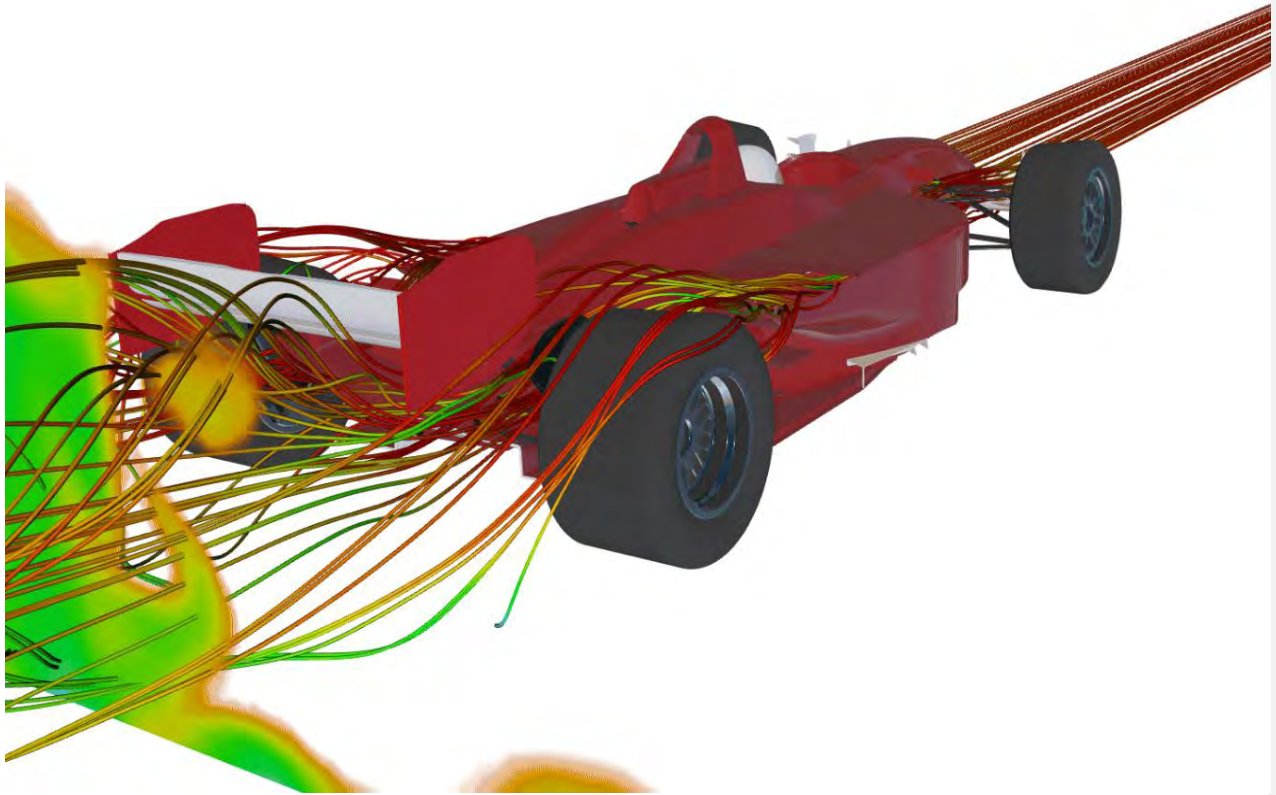


Camera matching tool

Correlate physical images and videos with CFD results



DrivAer model Courtesy Technical University of Munich



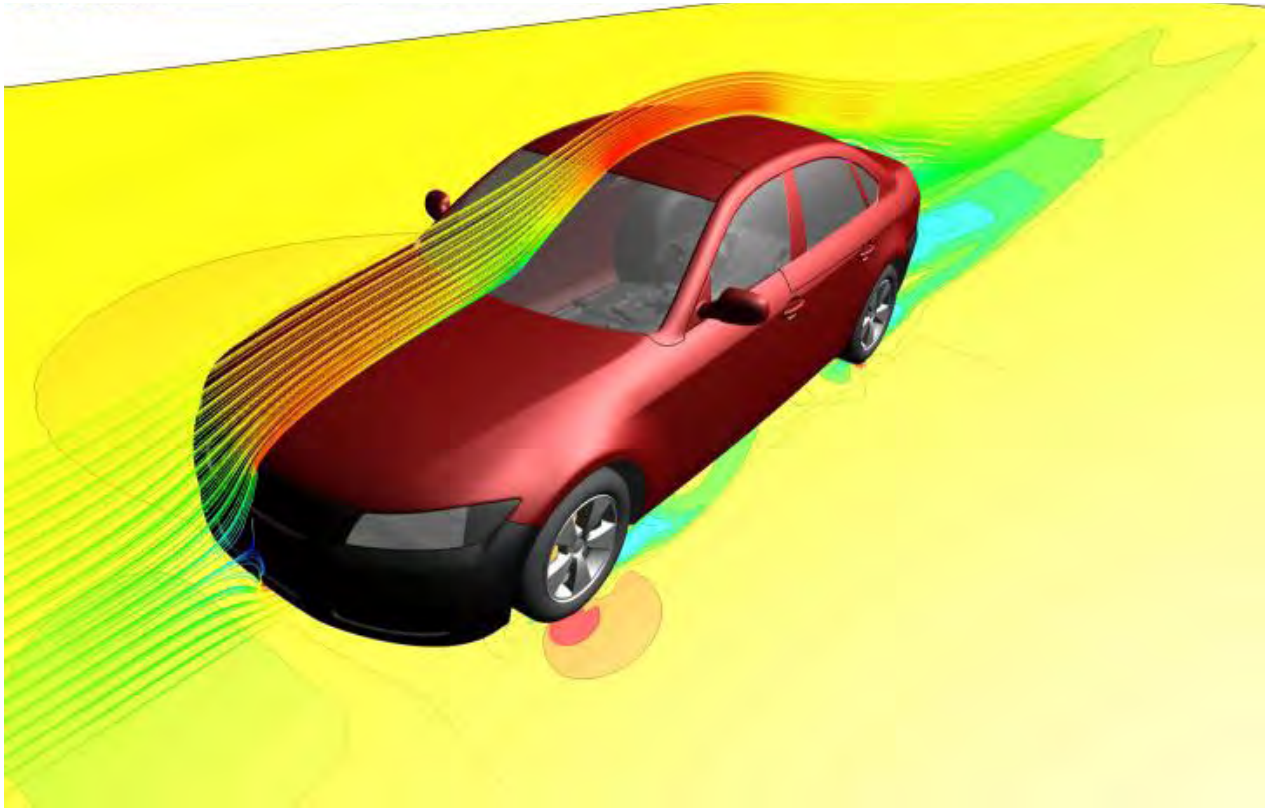
Animation editor tool for creation of flying camera videos

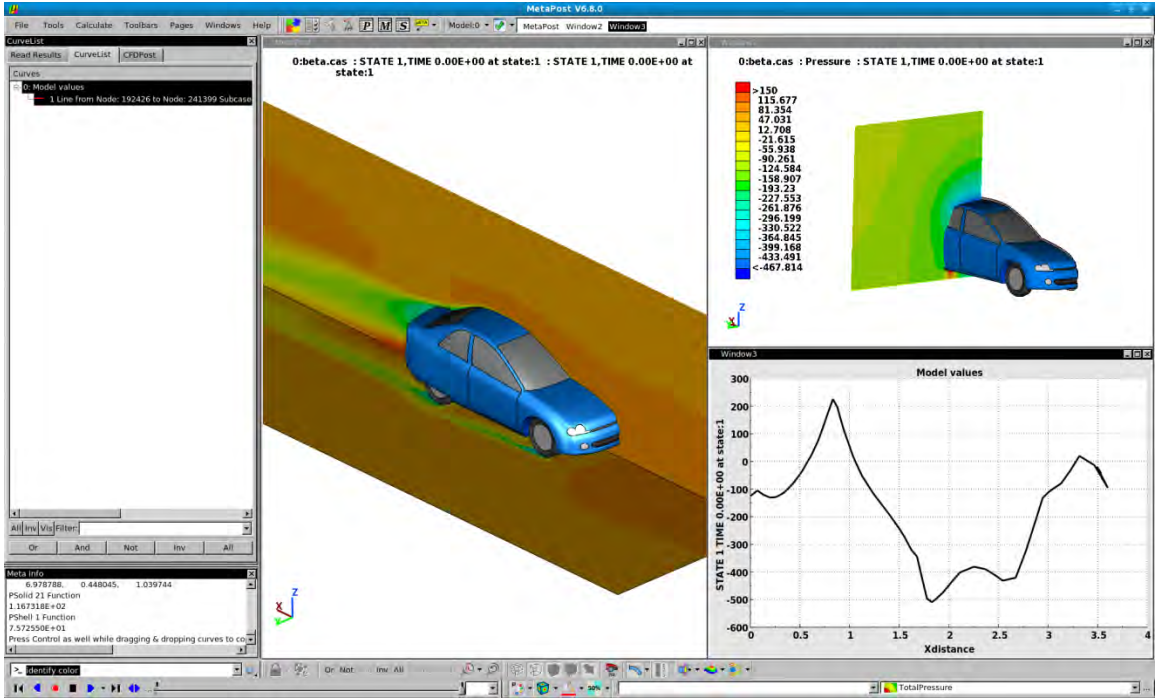
Materials rendering and environment mapping

Rendering with material textures

Textures from imported image files can be applied on models

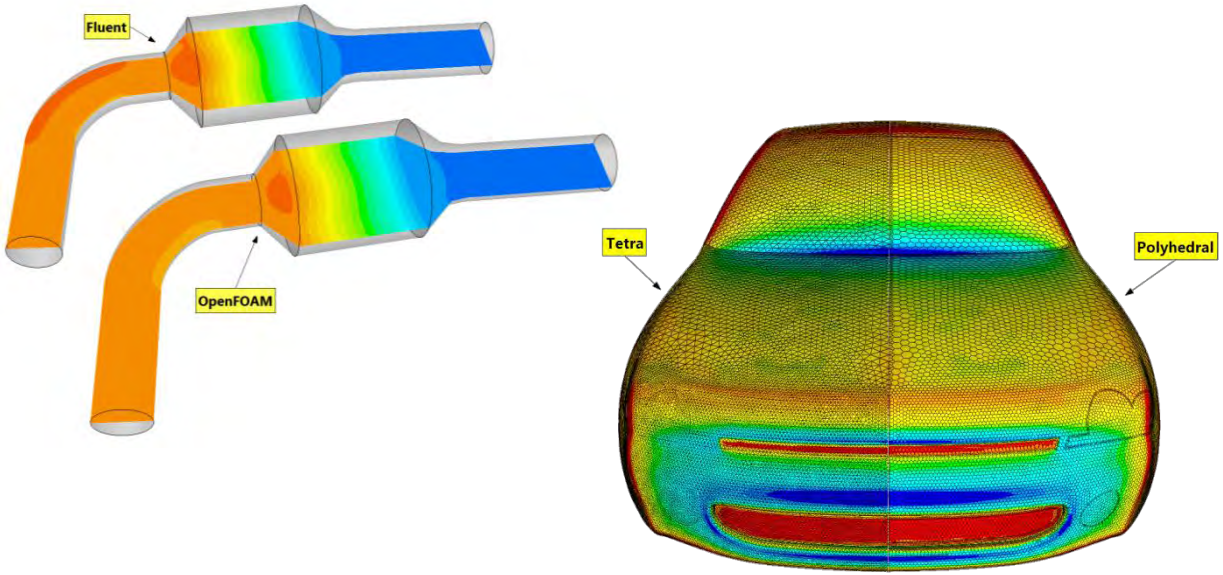
Multiple light sources





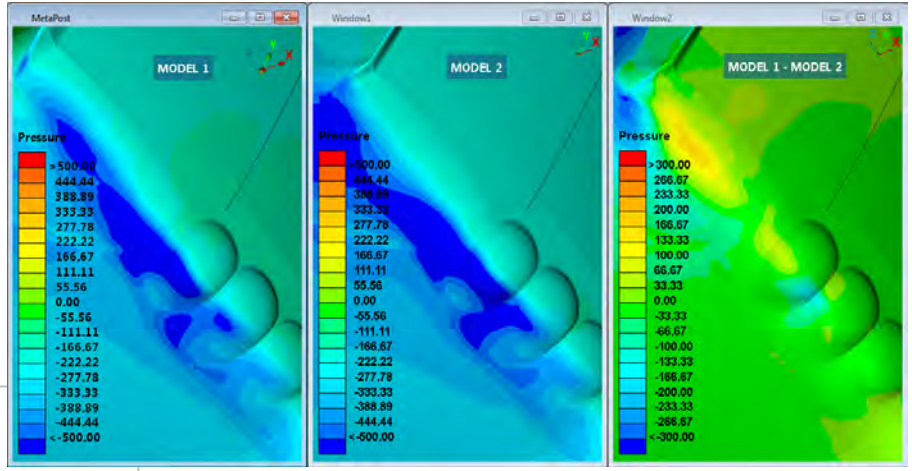
Multiple windows

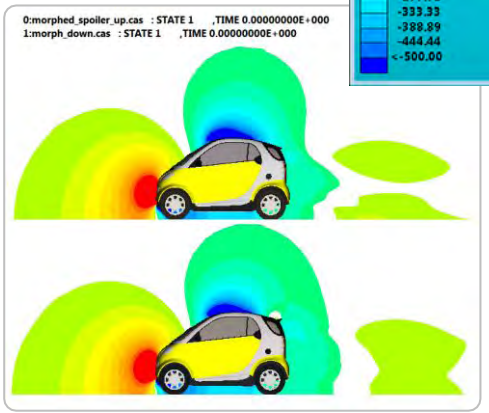
- 3d and 2d windows
- Setup styles and entities visibility per window
- Different models can be placed in one or more windows



Multiple model handling and comparison

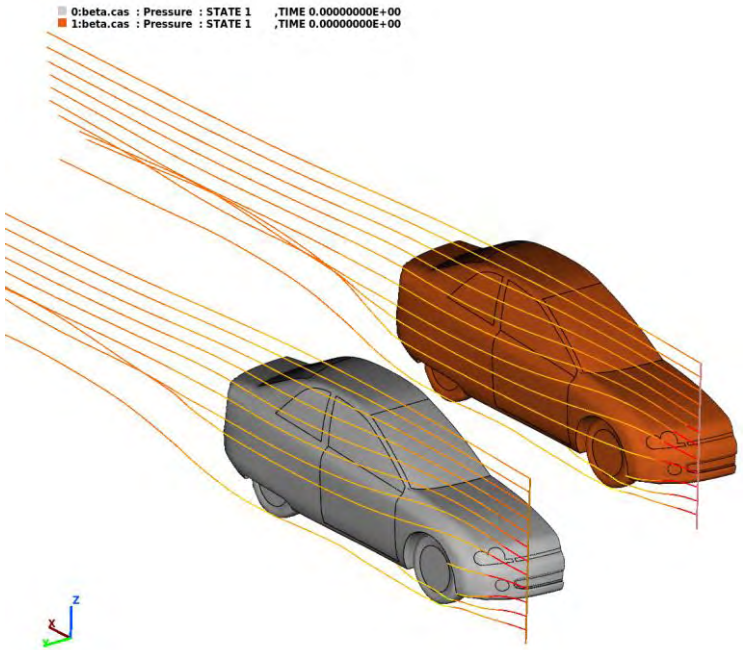
Load multiple models and compare cases from different solvers, meshes, physical models and numerical setups





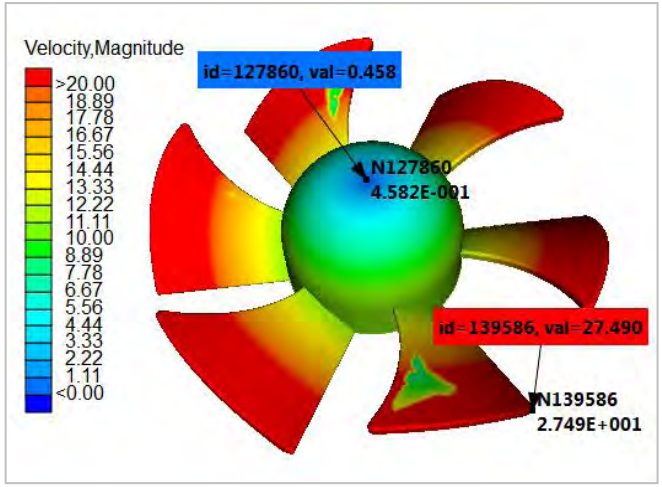
Multiple model handling and comparison

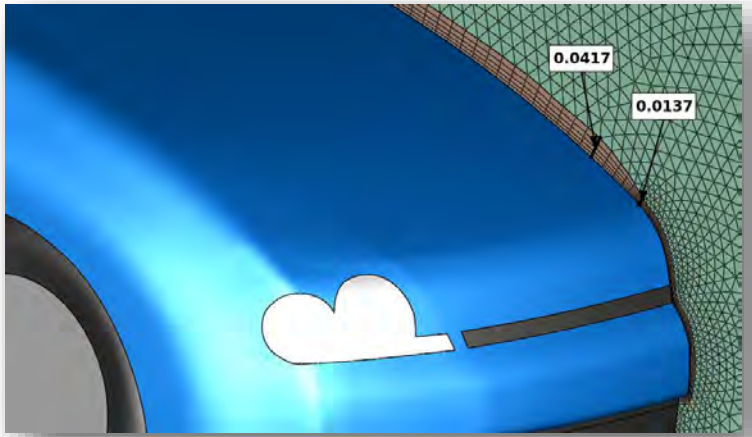
Map results from one model to another and calculate their differences

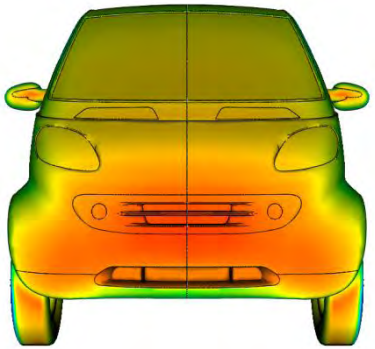


Session file support for replaying all post-processing actions

- Overlay and compare multiple iterations of data
- Set the respective files or paths of the second model
- All new data are automatically overlaid on the respective windows



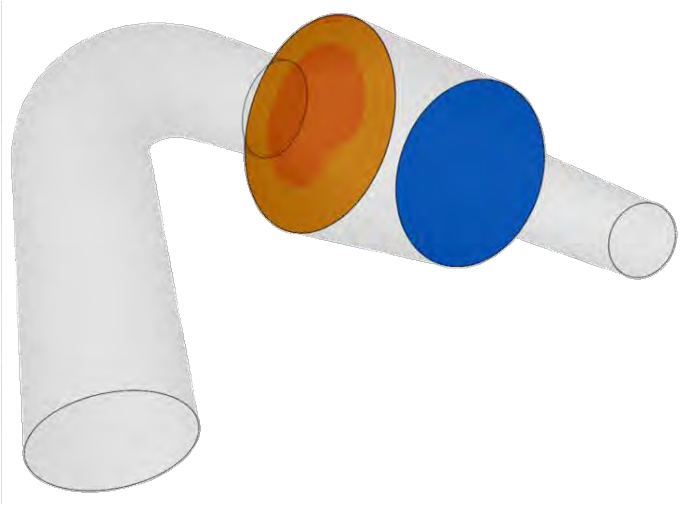




Projected Area: 1.884

Query of model dimensions

- Measurement of distance, angle, area
- Projected Area measurement Identify Min/Max values or critical areas
- Annotations



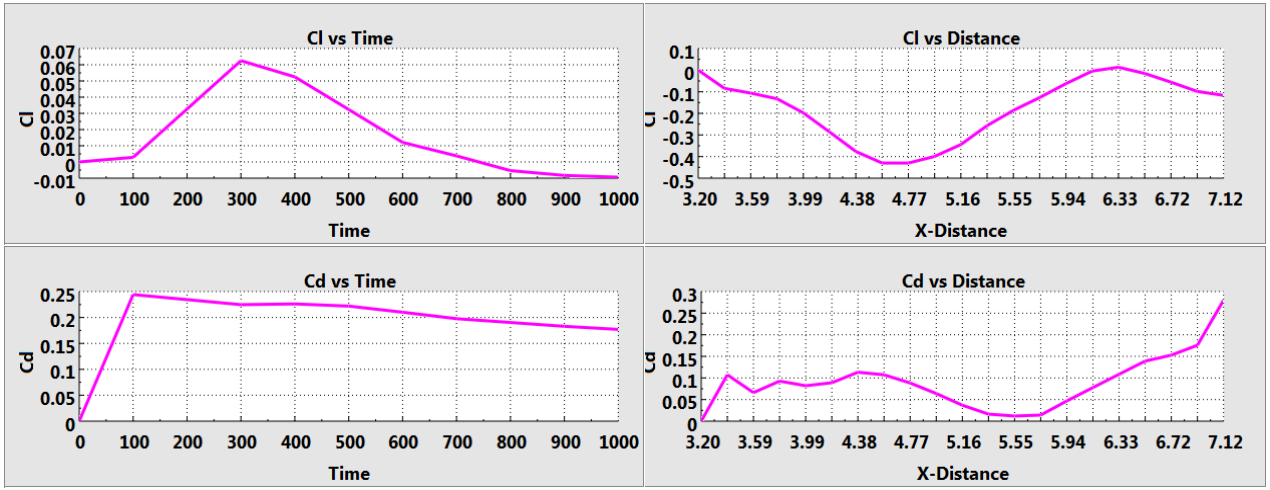
```
Surface Integrals
- - - - - - - - -
Pid     Name                        Area Weighted Average
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
2       interior_downstream_cat     1187.68000
3       interior_upstream_cat       17057.3000
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Sum                                 18244.98
Avg                                 9122.49
Diff                                15869.62
```

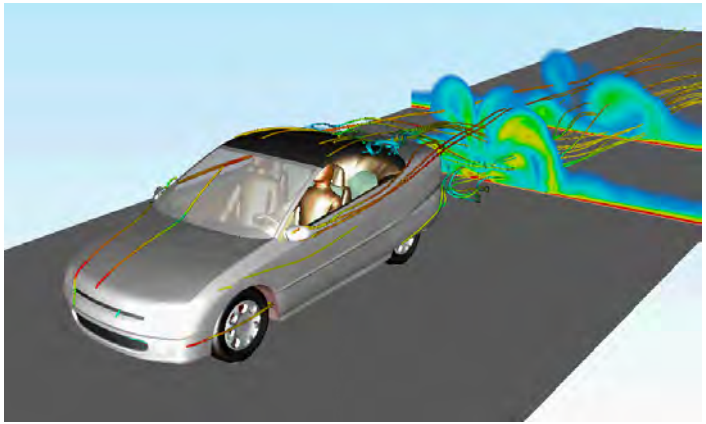
Calculation tools

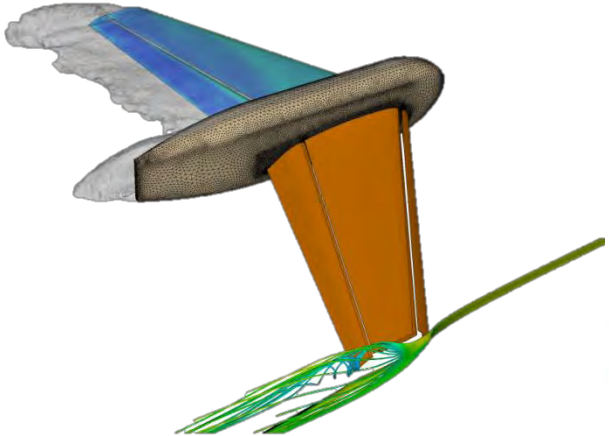
- Drag/Lift Forces and Coefficients
- Moments
- Surface/Volume integrals
- Results Sum, Average, Difference
- Pressure Drop example:

2D Plots

Cd/Cl plots vs Time/Distance







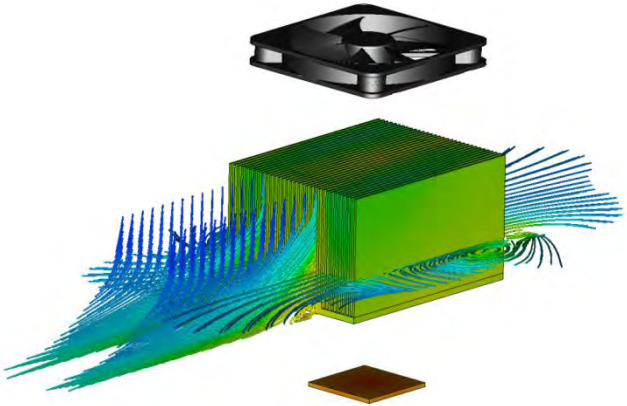
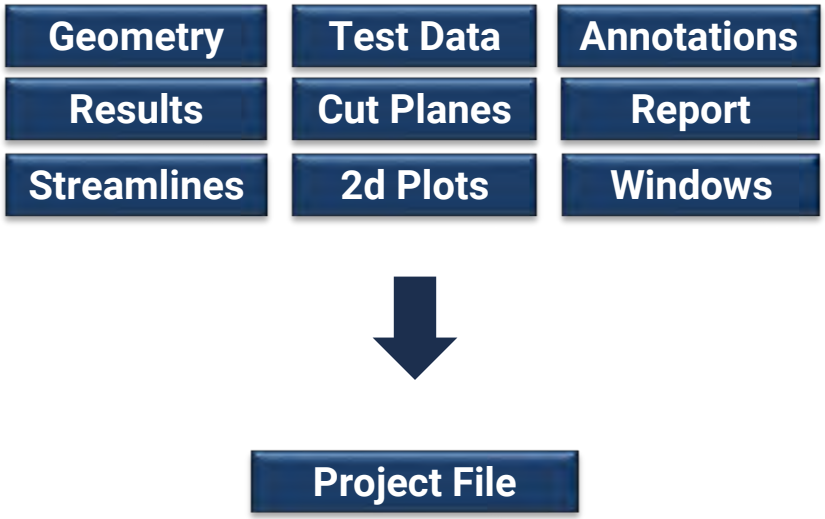


Image and video output in numerous formats

- JPEG
- PNG
- TIFF
- BMP
- GIF
- PS
- EPS
- MPEG
- AVI
- Animated GIF

META Project file

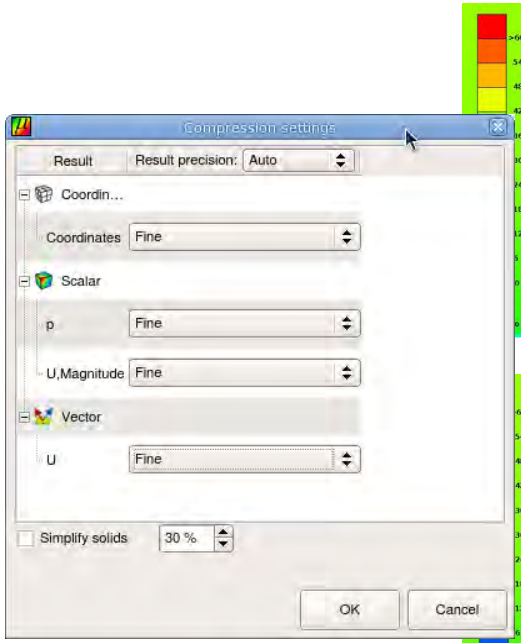
Output all current entities, results & objects in a project file

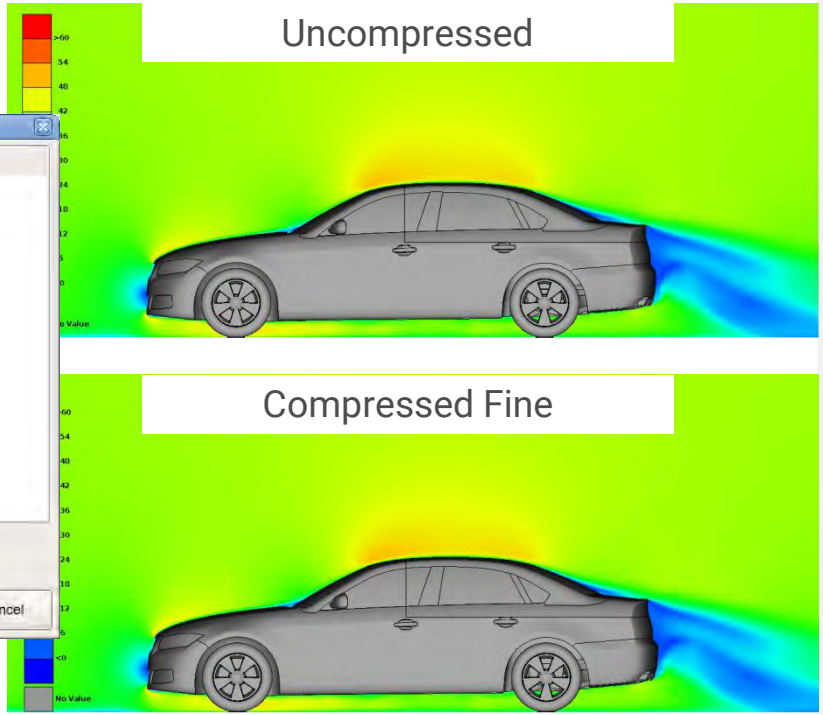


META native binary format file

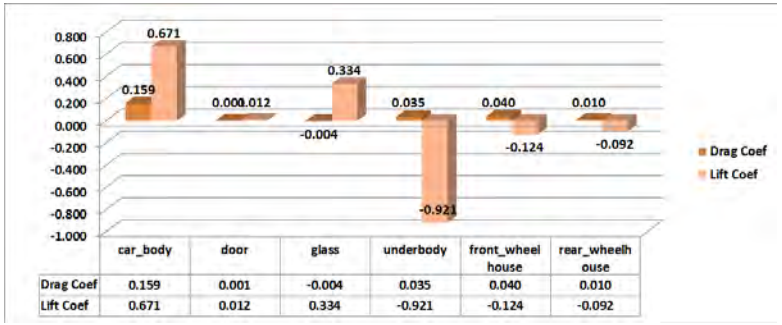
Data compression of project files

META offers the possibility to save a Project file with compressed data leading to significant file size reduction without loss of accuracy

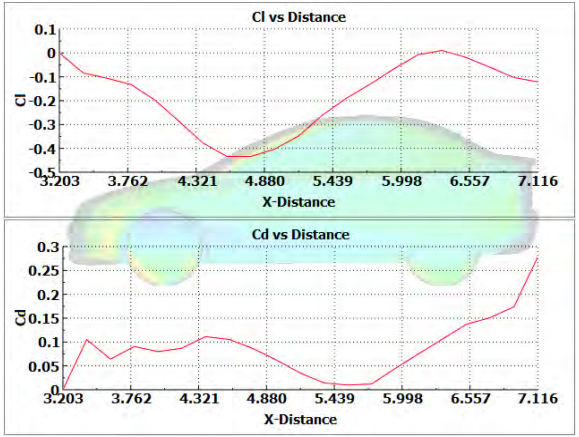


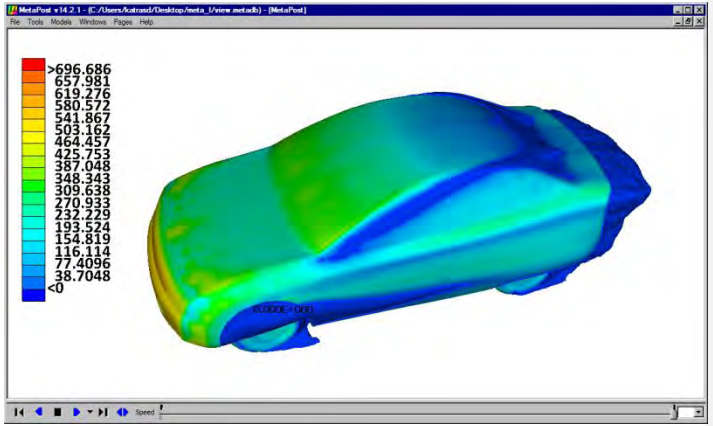


Summary report



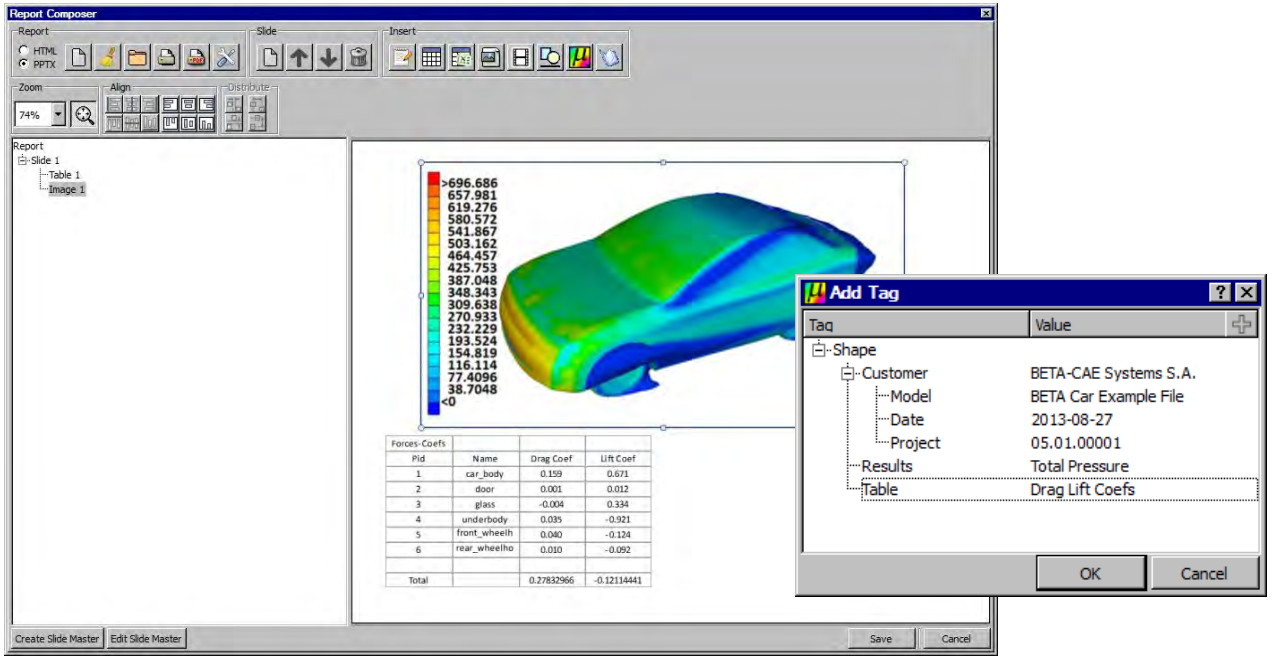
Forces-Coefs			
Pid	**Name**	**Drag Coef**	**Lift Coef**
1	car_body	0.159	0.671
2	door	0.001	0.012
3	glass	-0.004	0.334
4	underbody	0.035	-0.921
5	front_wheelhouse	0.040	-0.124
6	rear_wheelhouse	0.010	-0.092
Total		**0.27832966**	**-0.12114441**





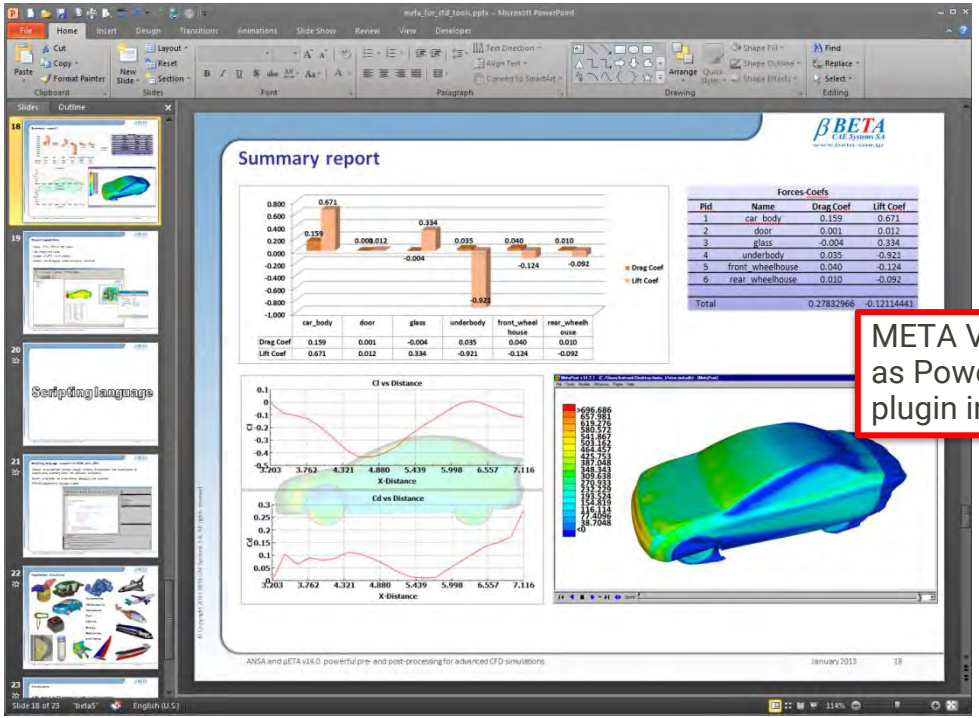
Report capabilities

- Create HTML, PPTX or PDF reports
- Add images and videos
- Support of META viewer objects
- Reports can be tagged, stored and quickly recovered

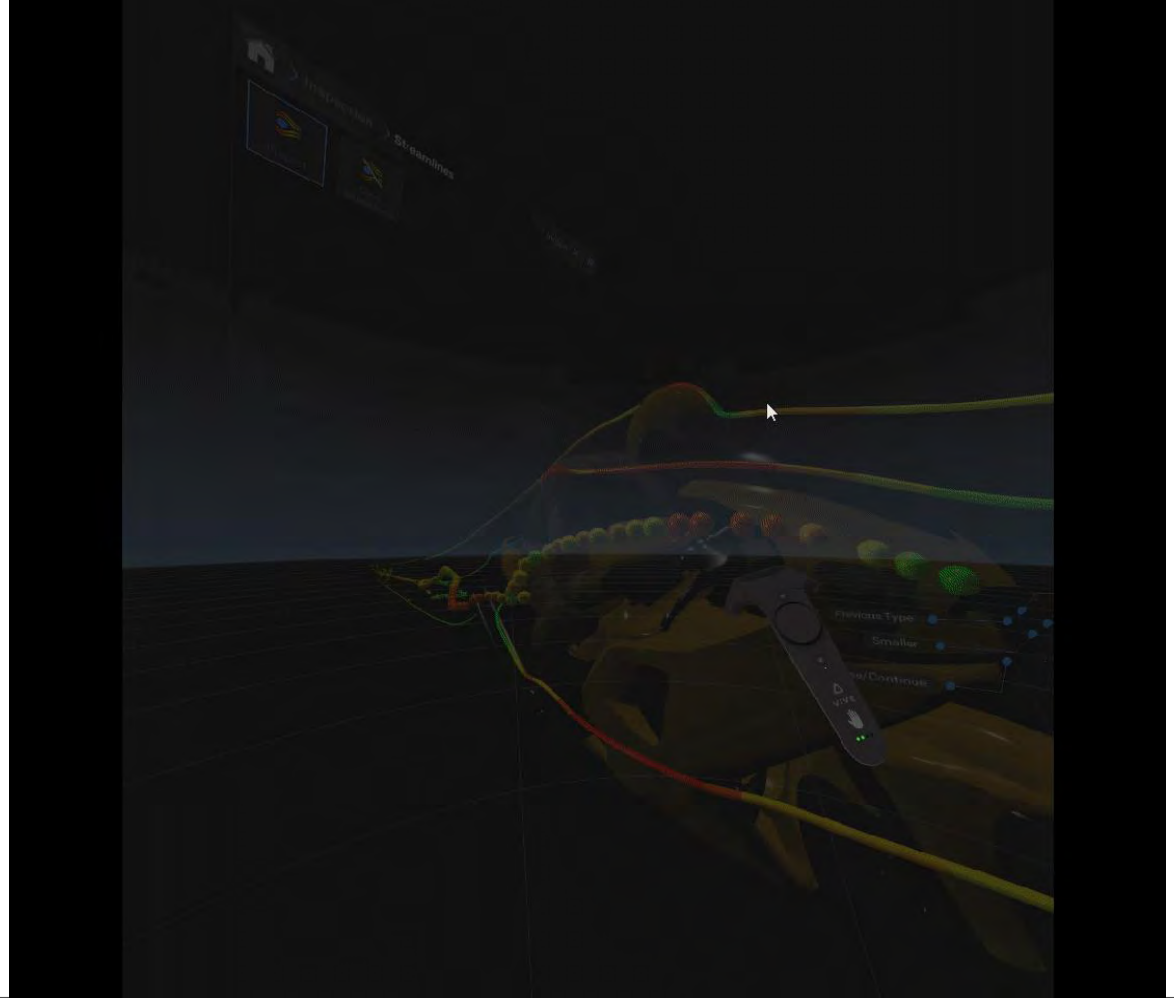


META viewer plugin

- License free reduced version of META
- Web Browser, PowerPoint Plug-in and standalone executable
- Loads Project Files only

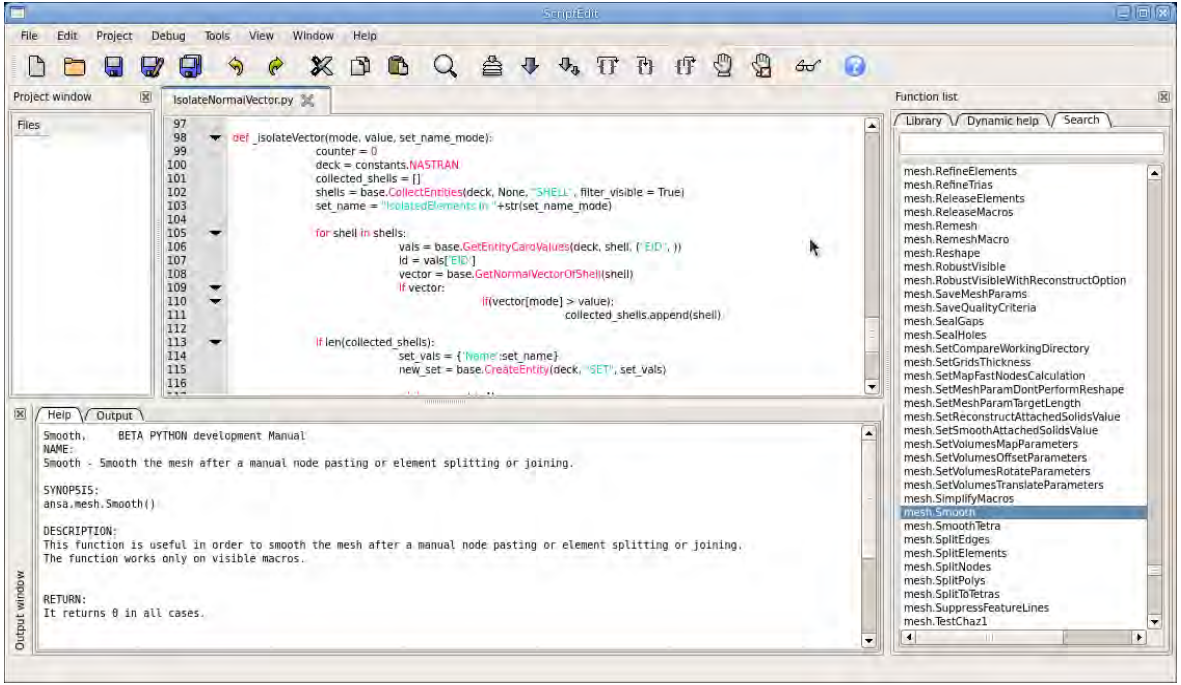


META Viewer as PowerPoint plugin in slides



Virtual Reality CFD post-processing

Script language



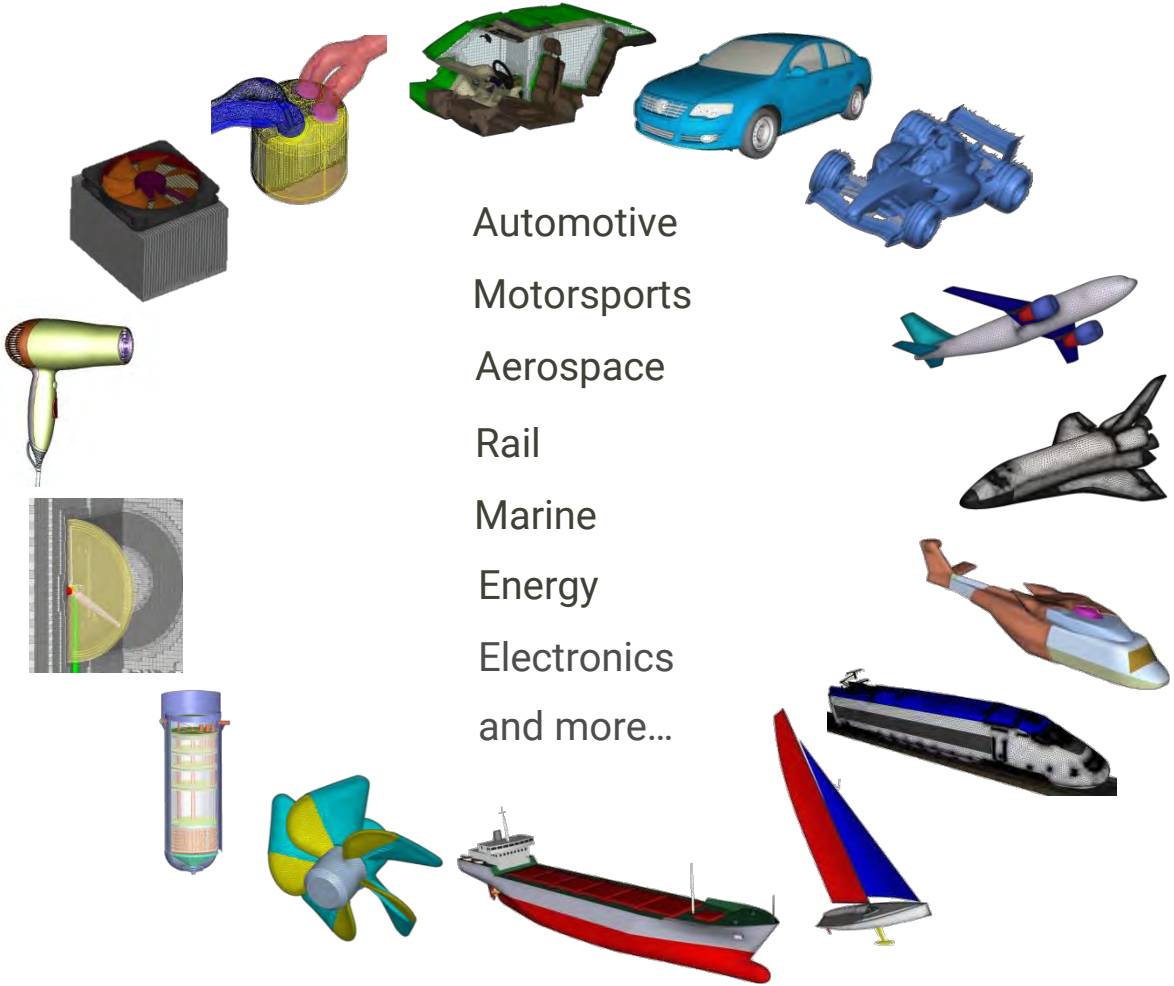
PYTHON scripting support

Creation of user defined functions through scripting for automation and customization of specific tasks, extending further the software's functionality

Build-in script editor for script creation, debugging and execution

PYTHON programming language support

Application industries



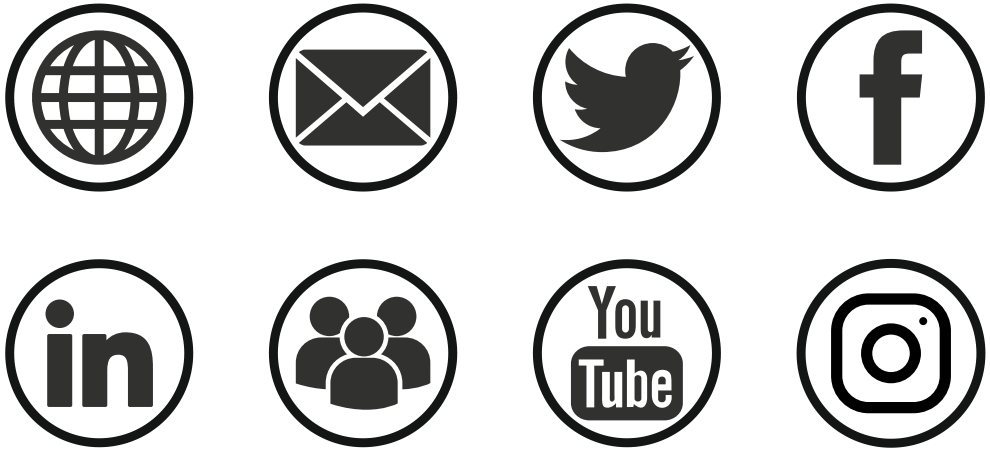
Conclusions

ANSA covers all the CFD pre-processing needs in a single environment, from CAD import, to advanced model management , geometry cleanup and preparation, automated surface and volume meshing and finally morphing and optimization.

It offers to the user the choice between high quality mesh generation on the geometry level and also quick meshing solutions like surface wrapping, depending on the needs and resources of the project.

ANSA provides high quality meshes for all CFD solvers, offering the possibility to make comparisons or use several codes depending on your needs and is also one common pre-processor platform for all other CAE disciplines, facilitating data exchange between different departments.

META provides powerful automated post-processing for CFD and integrates with ANSA as a complete pre and post-processing solution for industrial applications.



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