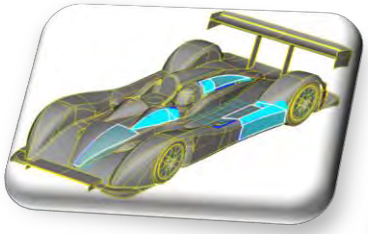
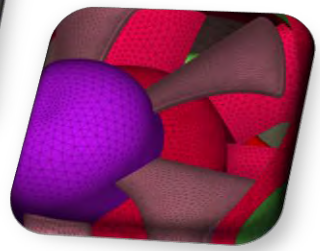
ANSA & µETA : powerful pre- and post-processing for advanced CFD simulations

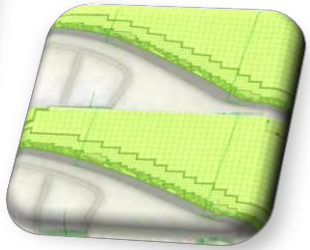
January 2015



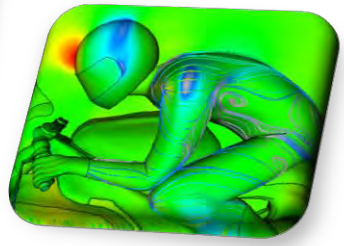
geometry



mesh



morph



results

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Fax :+30-392-021417
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URL : http://www.beta-cae.gr

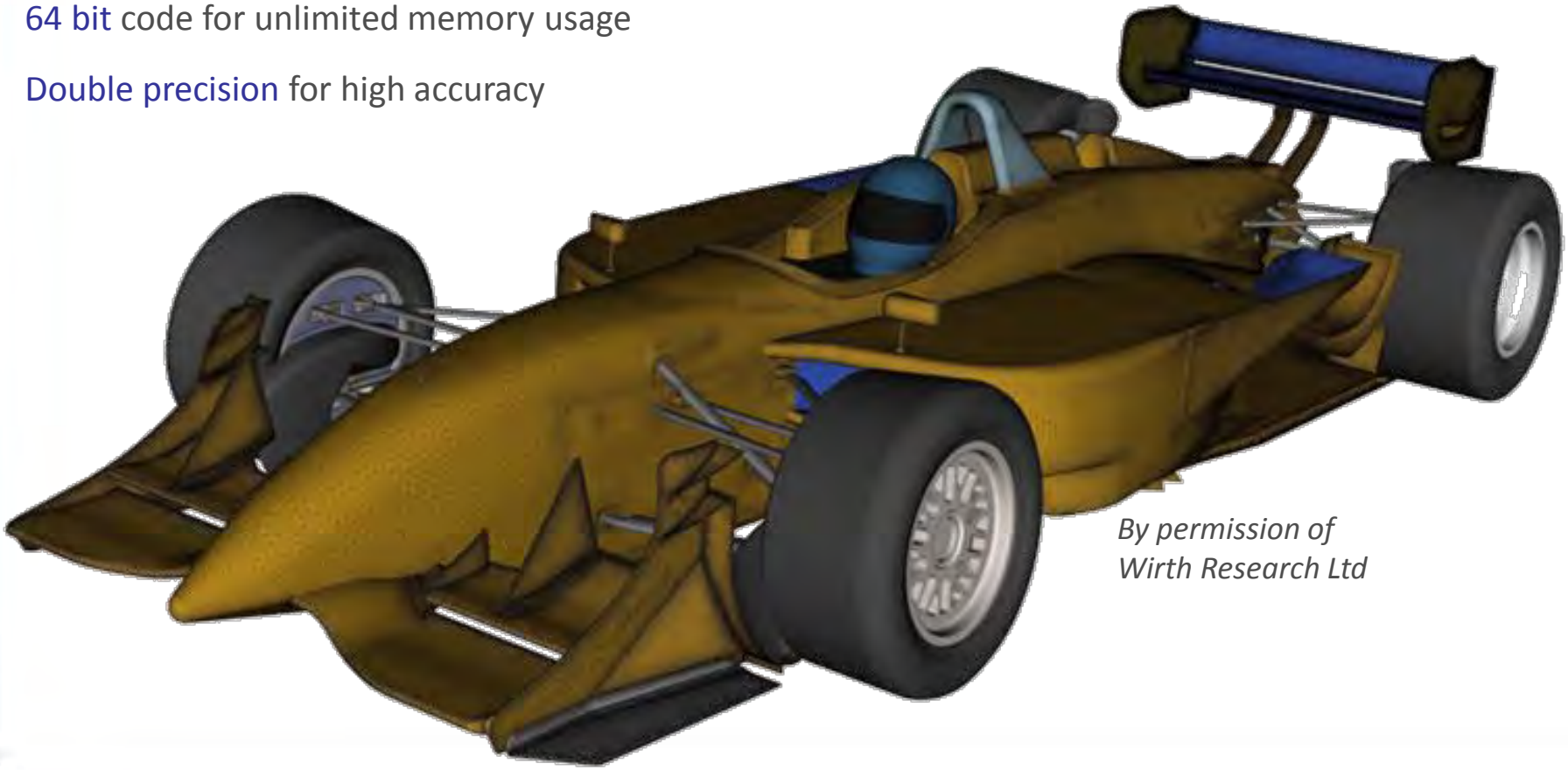
ANSA pre-processor specifications

Supported platforms:
- Linux
- Windows XP / Vista / 7 / 8
- MacOS

Parallel processing on multi core hardware for maximum speed

64 bit code for unlimited memory usage

Double precision for high accuracy



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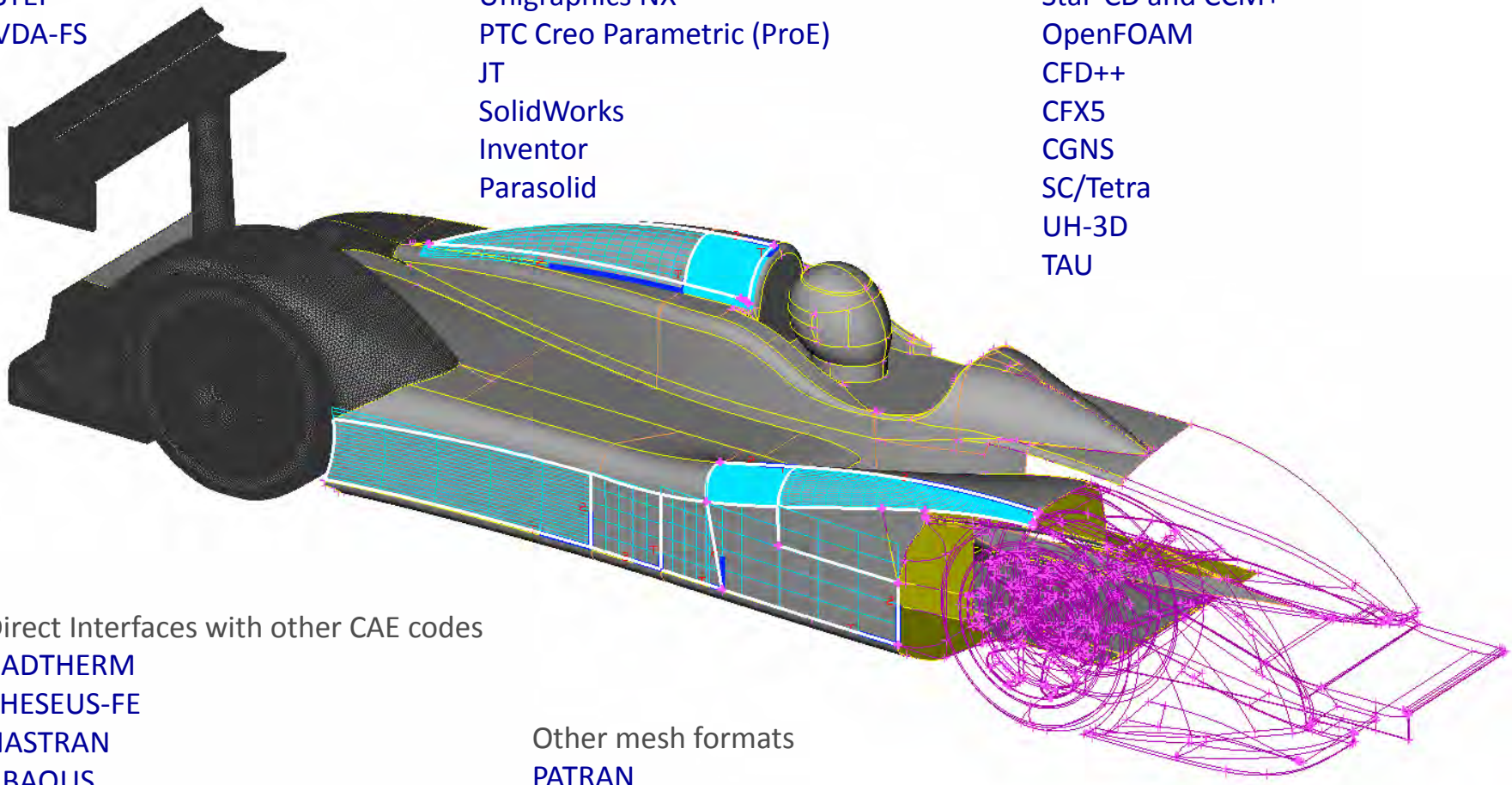
Input/Output

Neutral CAD formats:
IGES
STEP
VDA-FS

Native CAD formats:
CATIA V4 & V5
Unigraphics NX
PTC Creo Parametric (ProE)
JT
SolidWorks
Inventor
Parasolid

CFD formats:
Fluent
Star-CD and CCM+
OpenFOAM
CFD++
CFX5
CGNS
SC/Tetra
UH-3D
TAU



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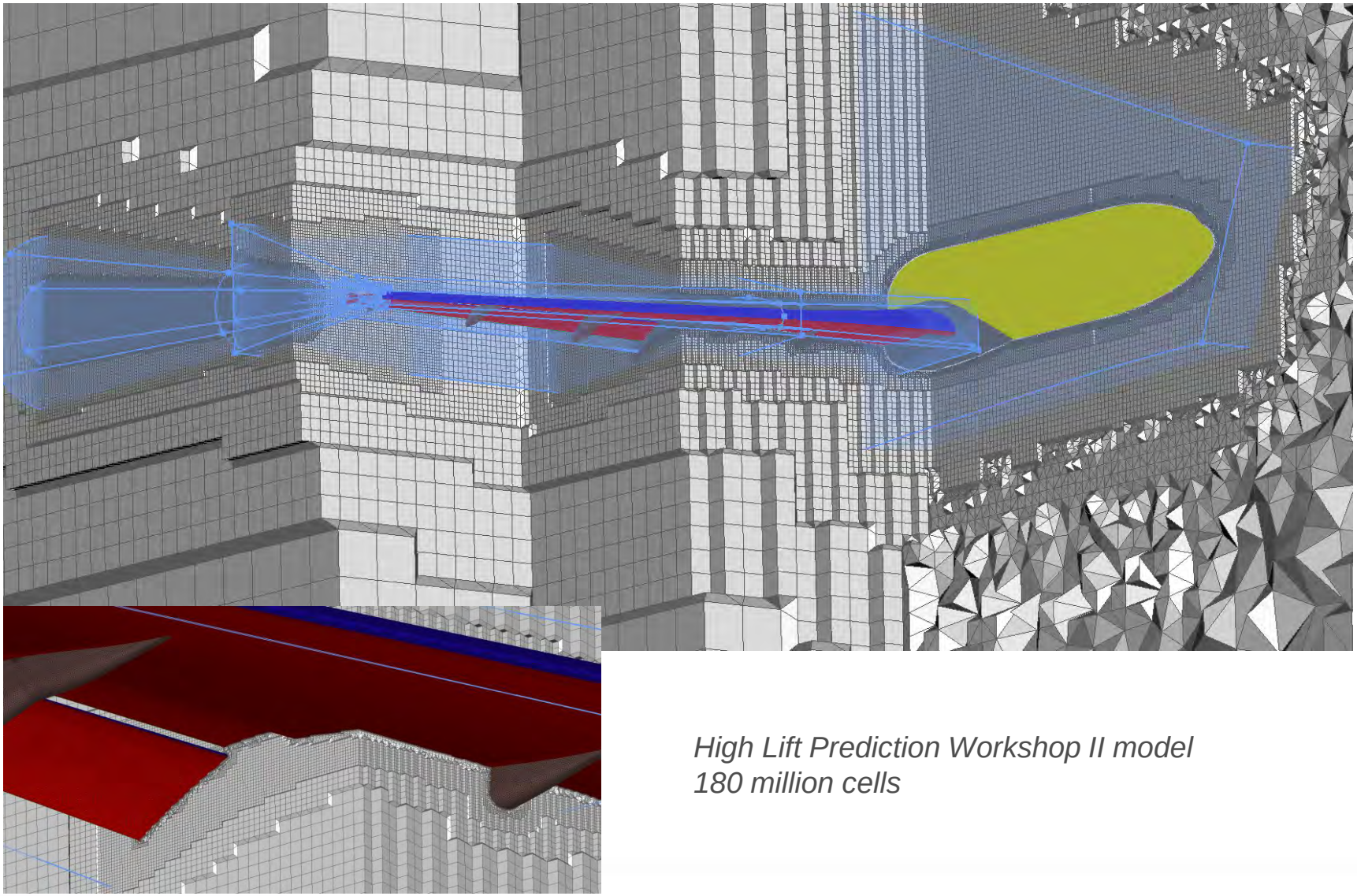
Direct Interfaces with other CAE codes
RADTHERM
THESEUS-FE
NASTRAN
ABAQUS
ANSYS
LS-DYNA
and more..

Other mesh formats
PATRAN
STL
VRML
and more..

Industrial scale pre-processing

Powerful generation and visualization of large CFD models



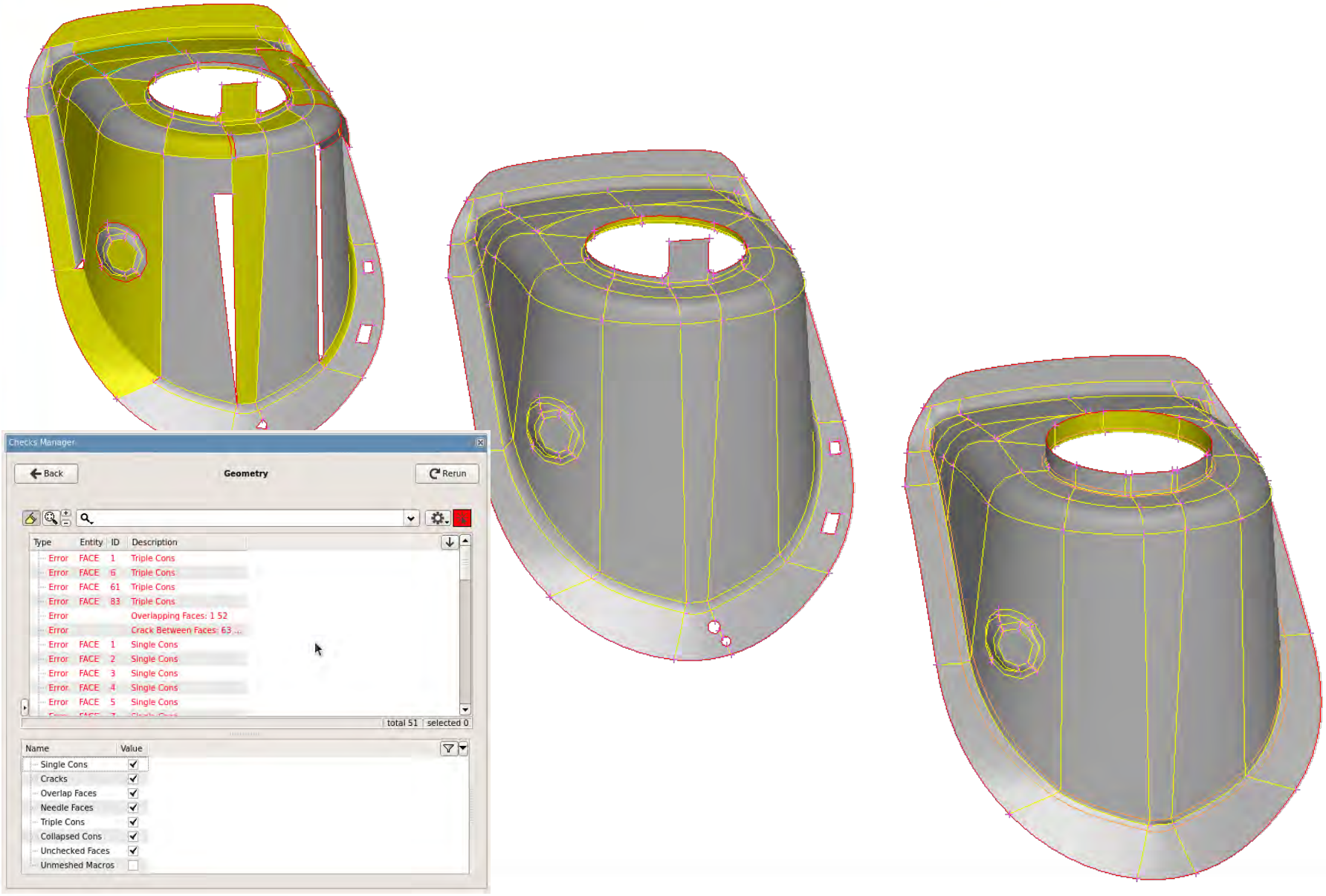
High Lift Prediction Workshop II model
180 million cells

Geometry

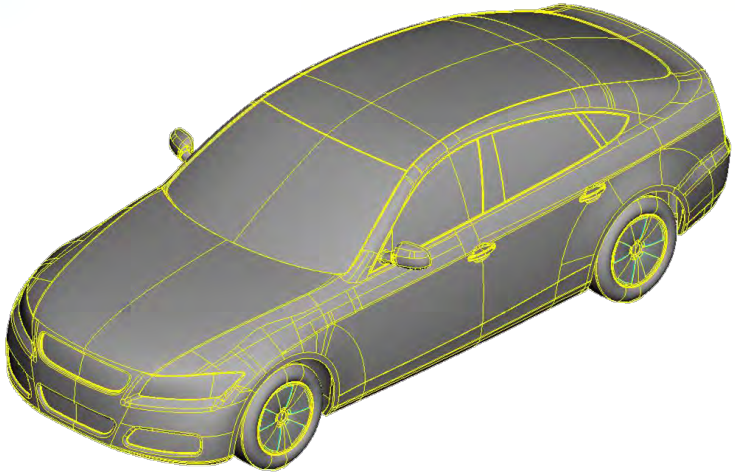
Geometry handling

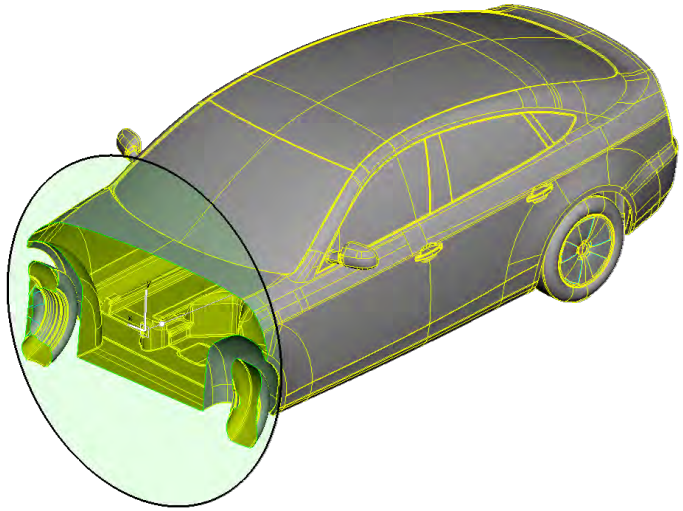
"CAD feel", easy-to-use functions for creation and manipulation of geometrical entities (points, curves, surfaces)

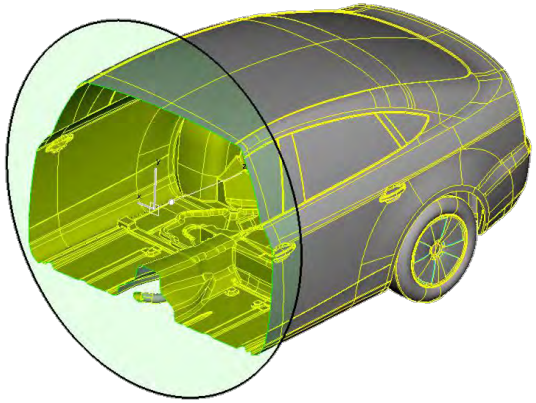
Geometry handling: Advanced automatic and manual clean up tools

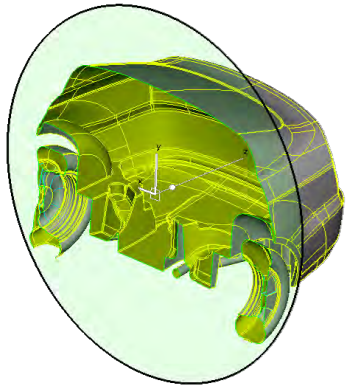


Cutting planes for model examination and cross section creation



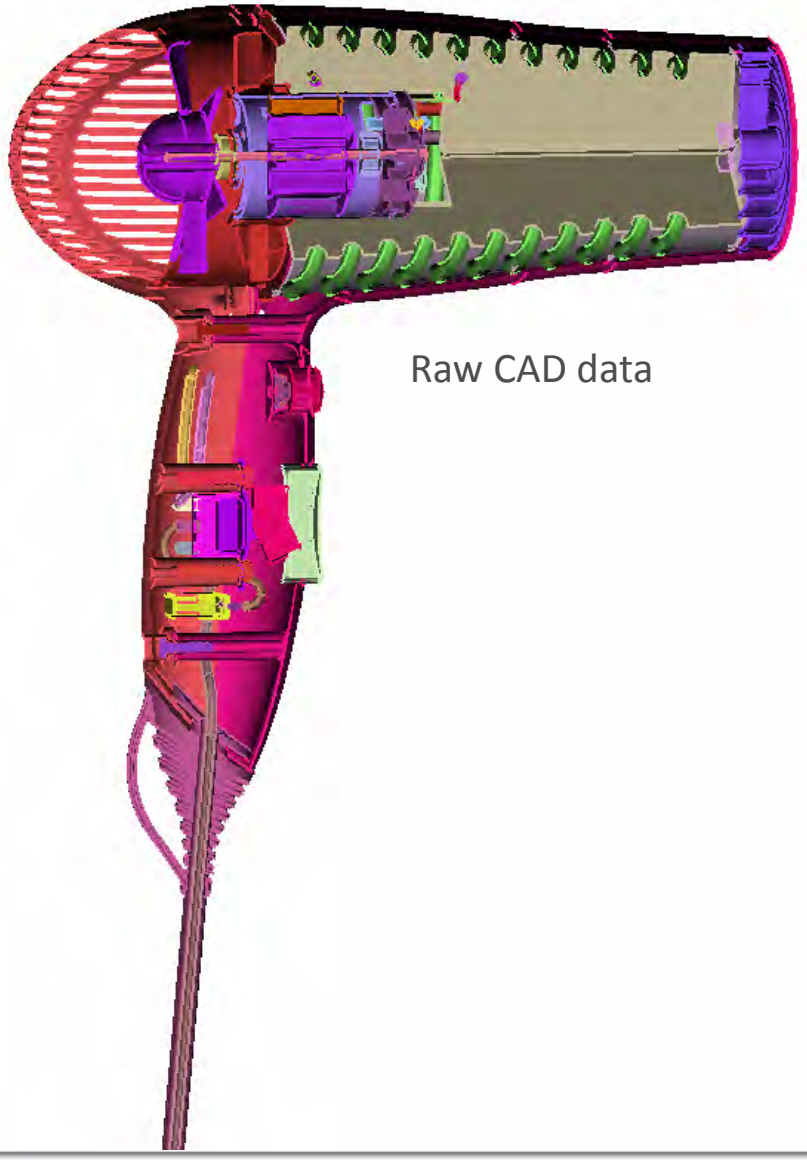




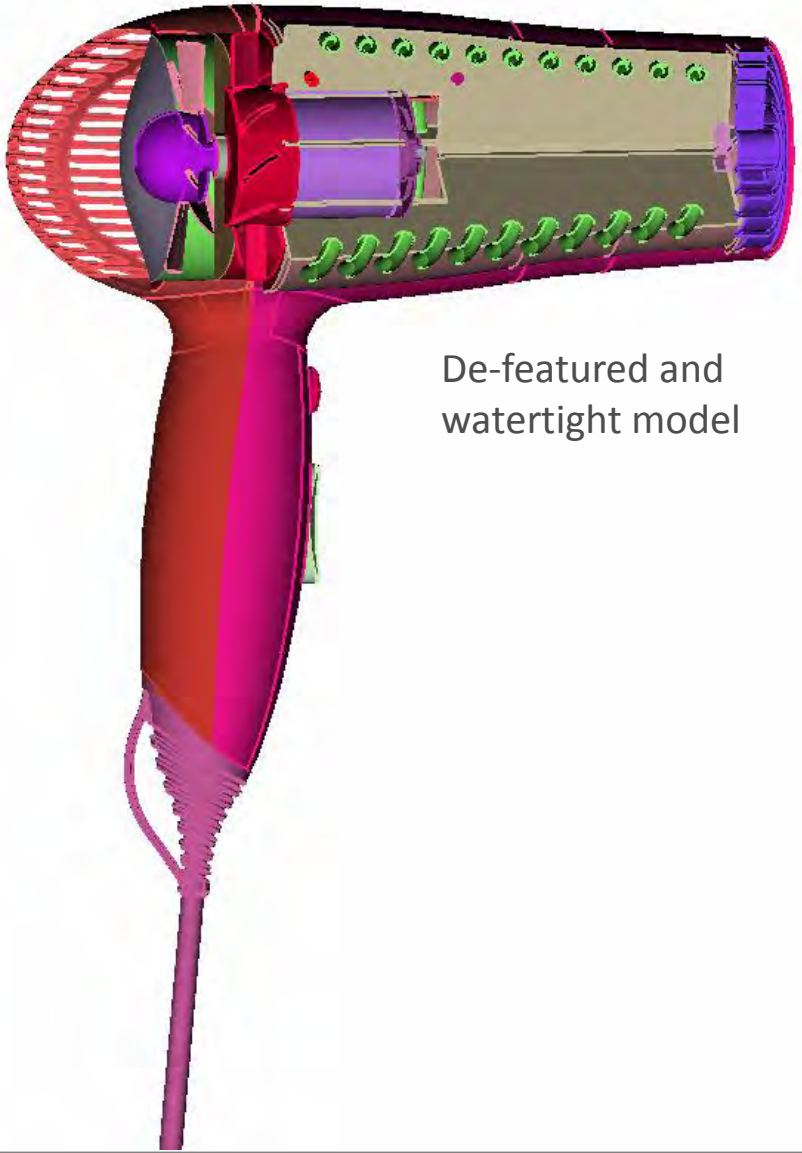


DrivAer model courtesy of Technical University of Munich

Geometry handling: De-featuring and watertight model preparation



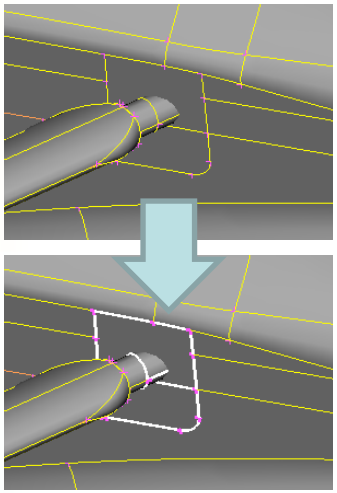
Raw CAD data



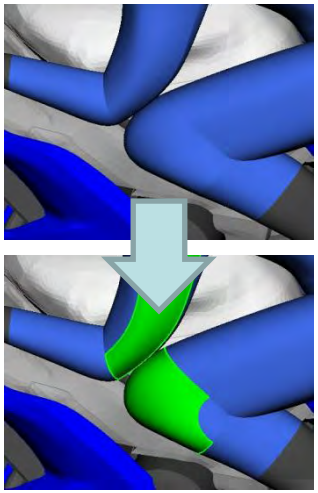
De-featured and watertight model

Geometry handling: identification and isolation tools for:

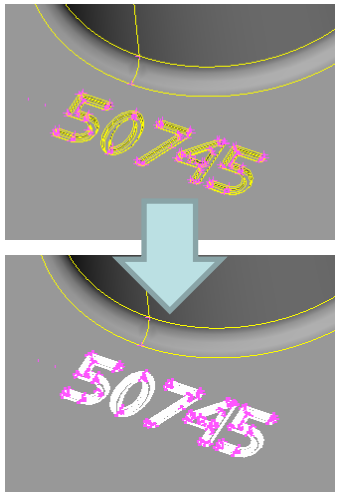
Intersections



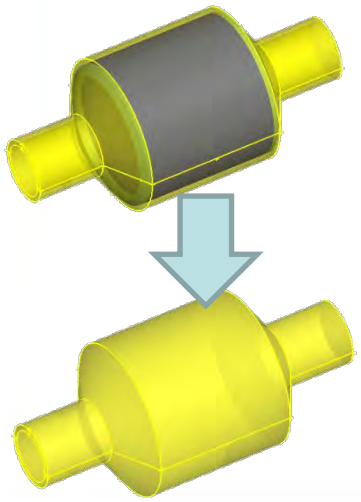
Contacts/Proximities



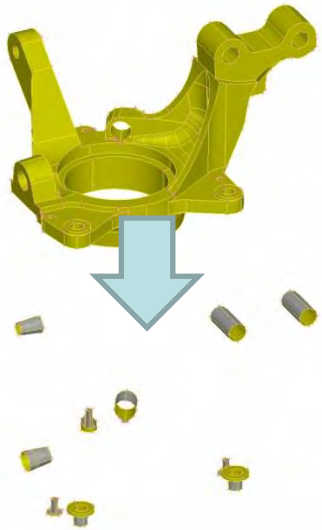
Emboss logos



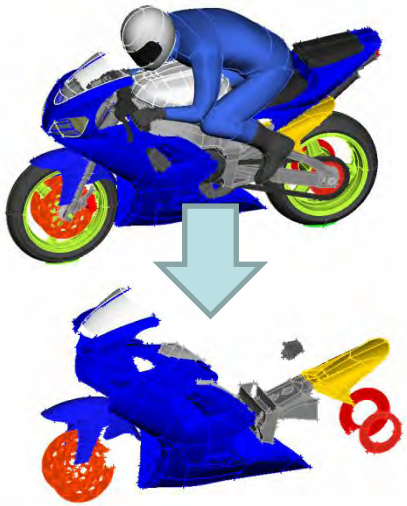
Outer skin



Inner passages

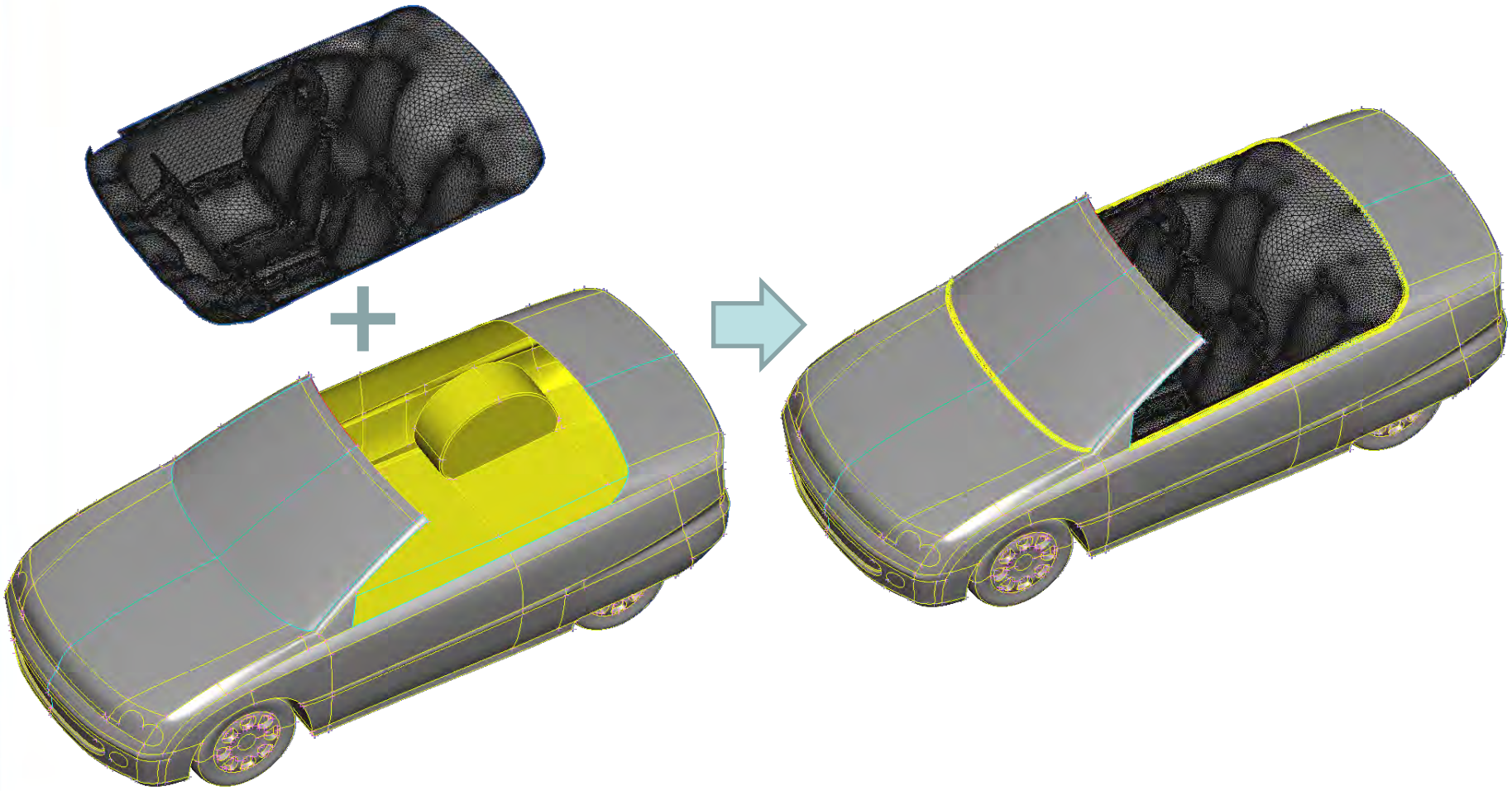


Baffles

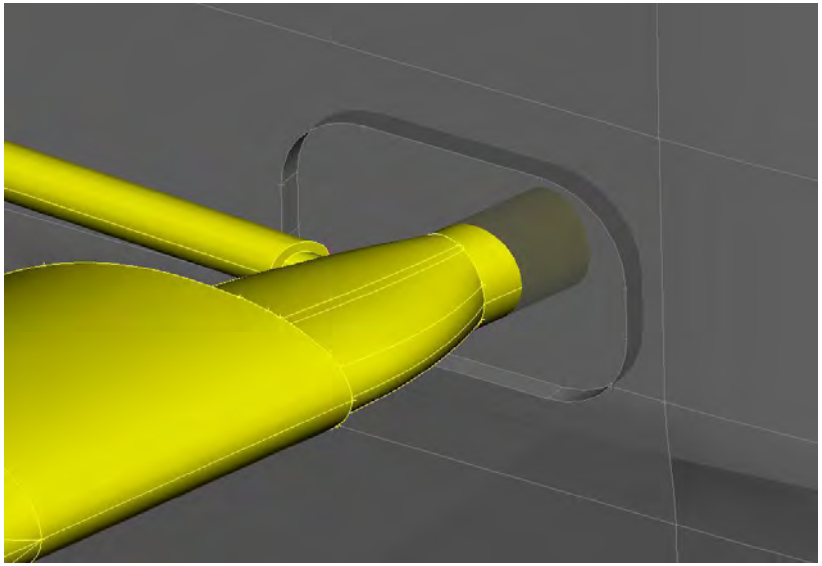


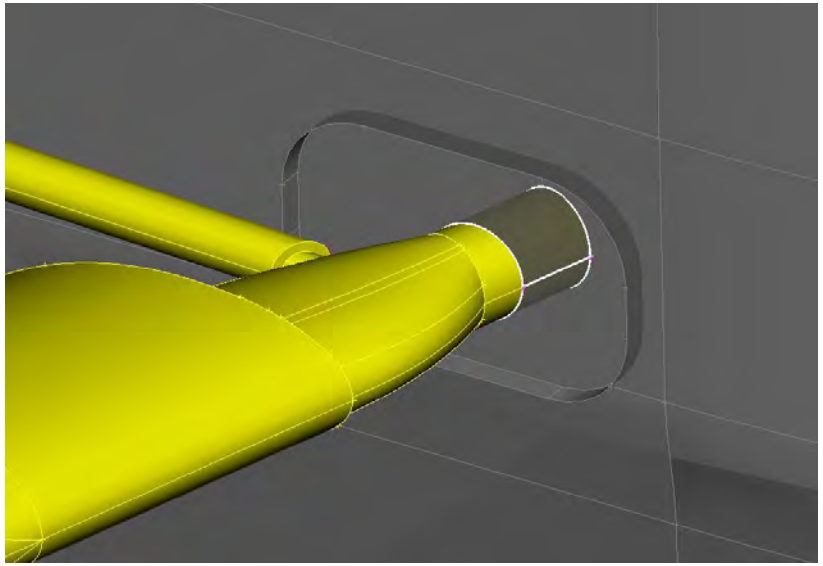
Combining geometry and FE-model mesh

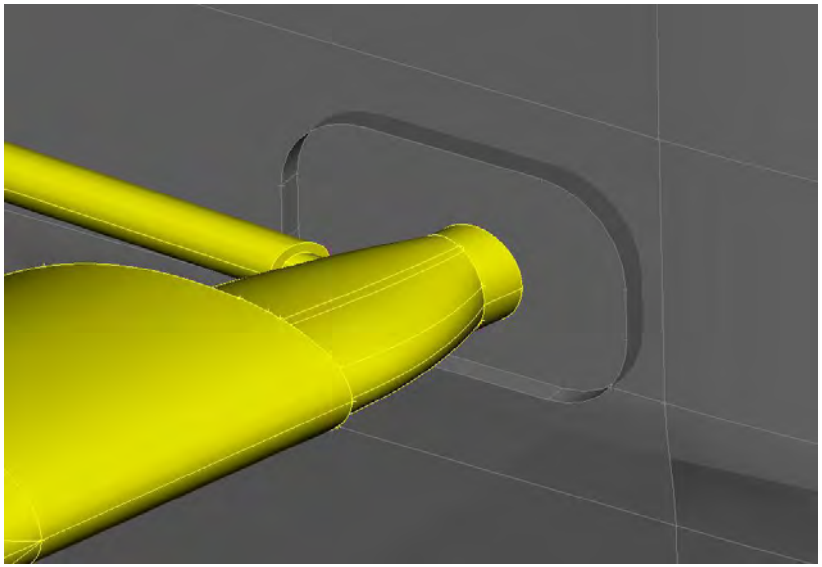
Powerful tools for management and connection of CAD geometry and existing FE-mesh

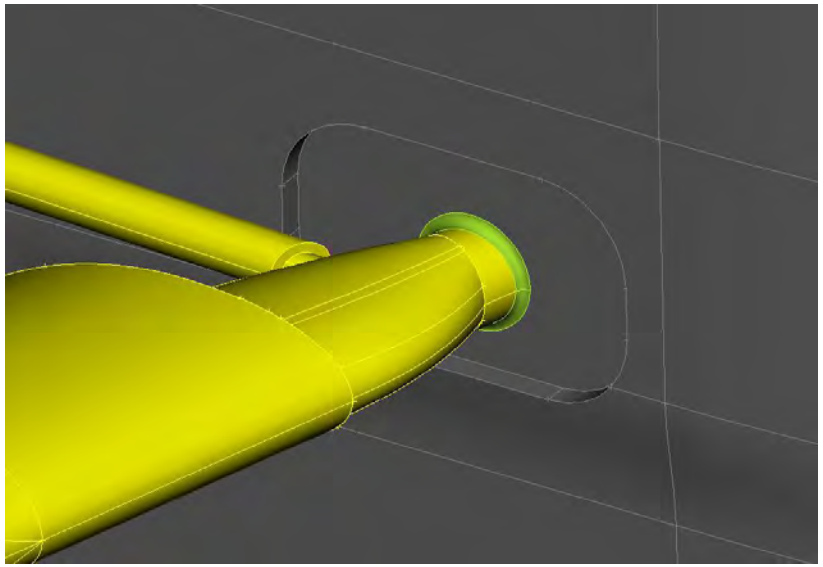


Boolean operations in geometry with option for fillet creation



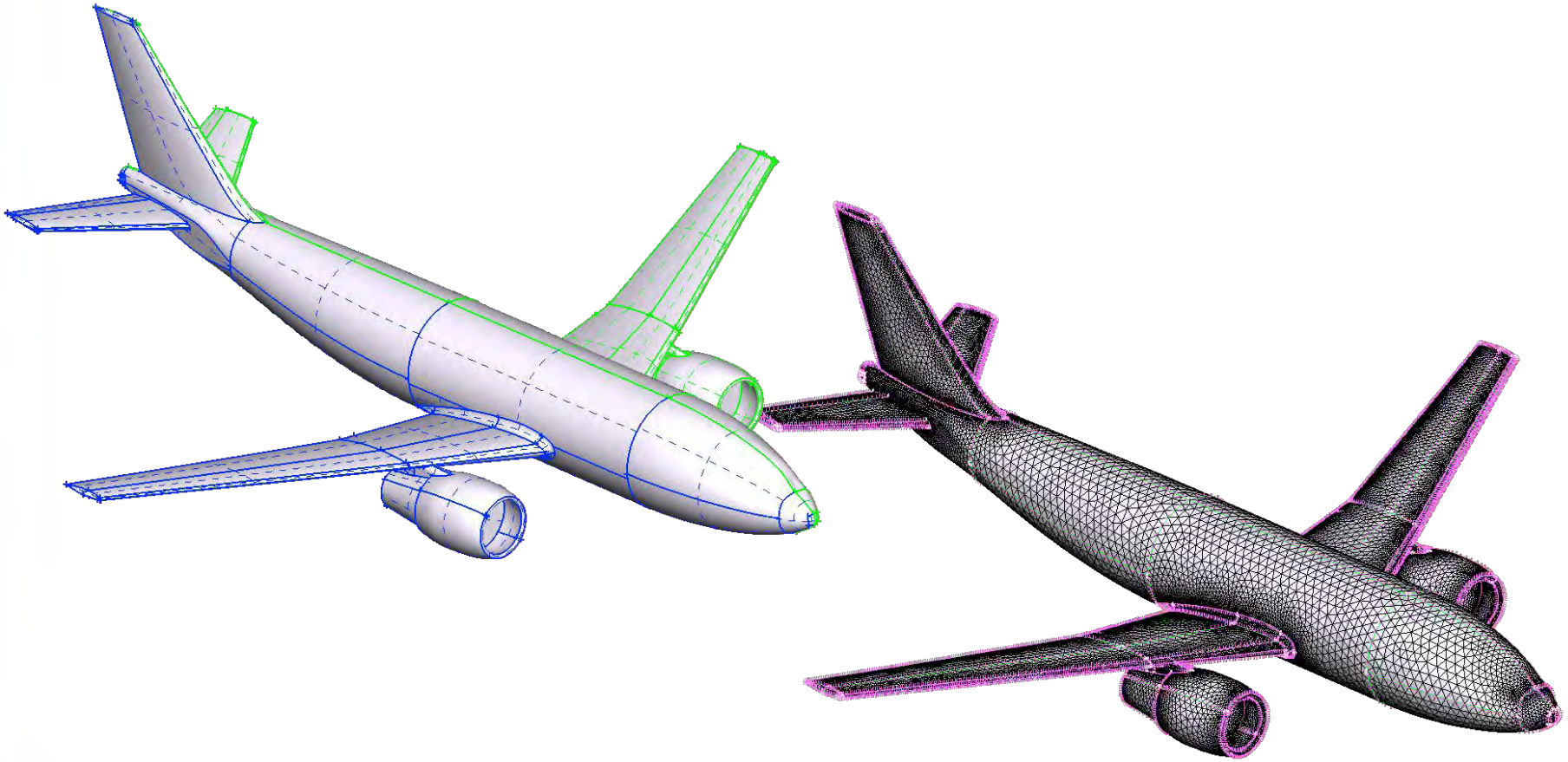






Geometry handling: Linked geometry

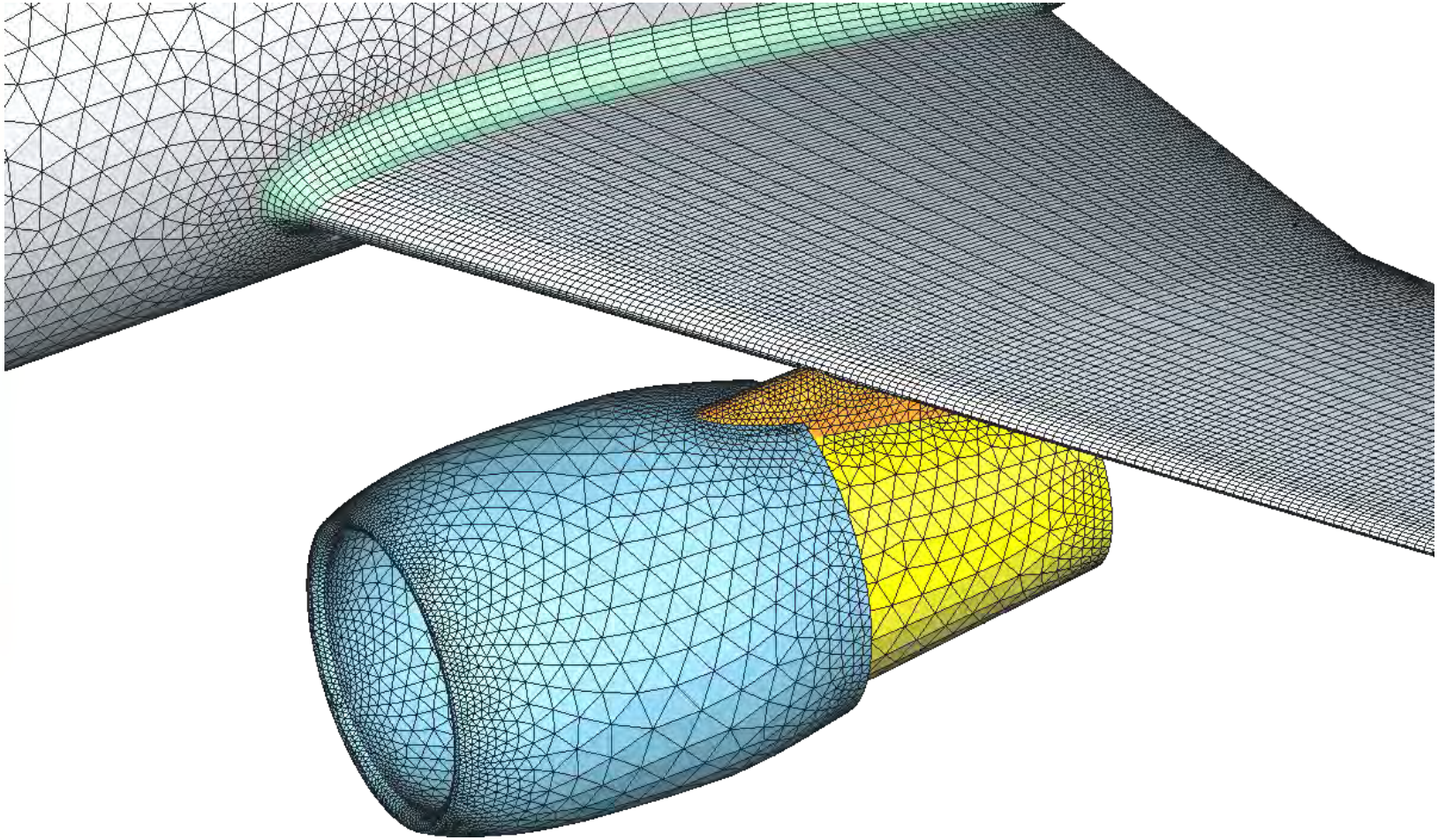
Speed-up model preparation using automatic identification of similar geometry & replacement with linked geometry



Surface Meshing

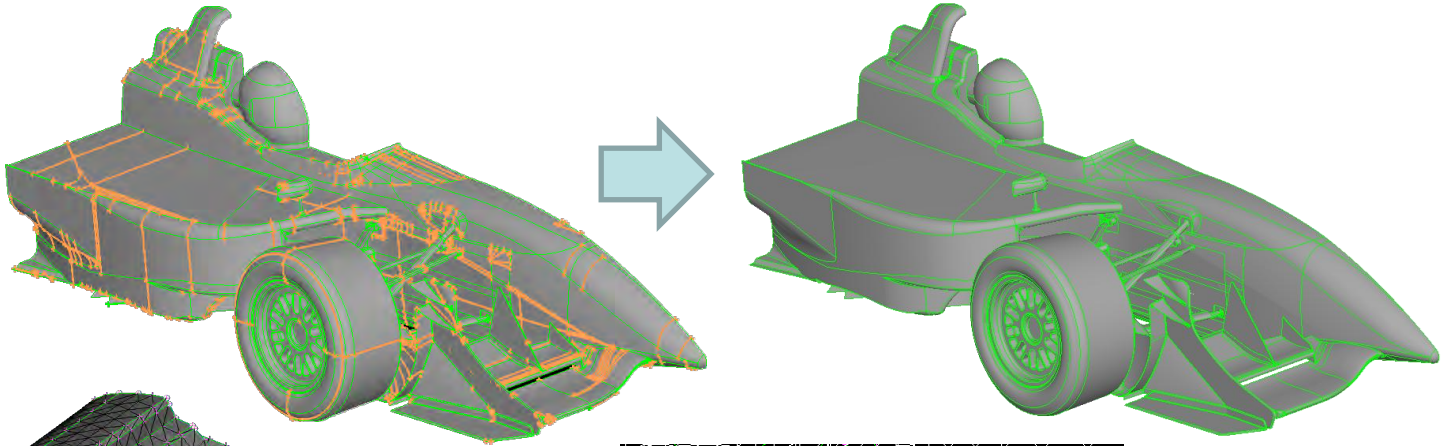
Surface meshing

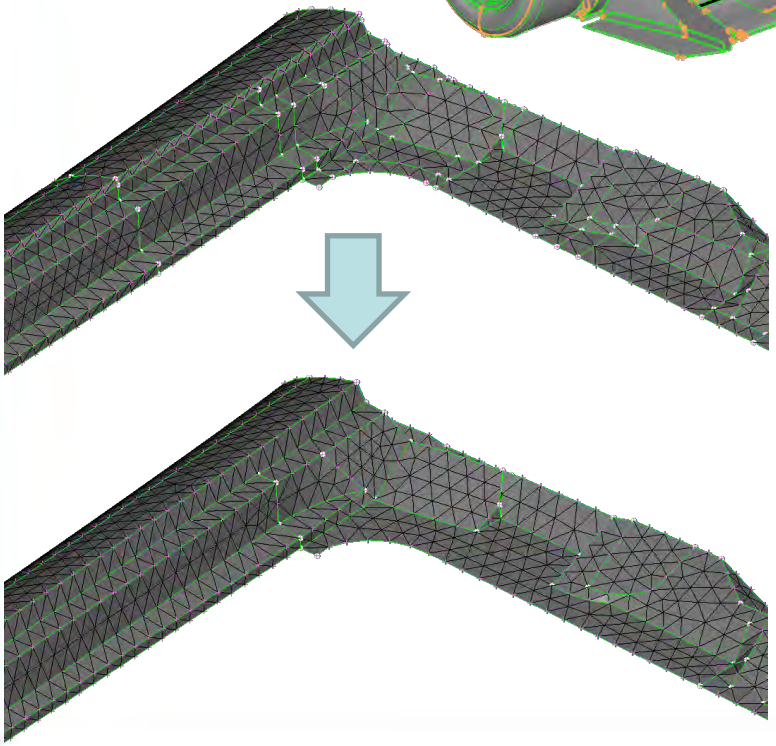
Multiple algorithms for tria, quad or mixed-type shell mesh

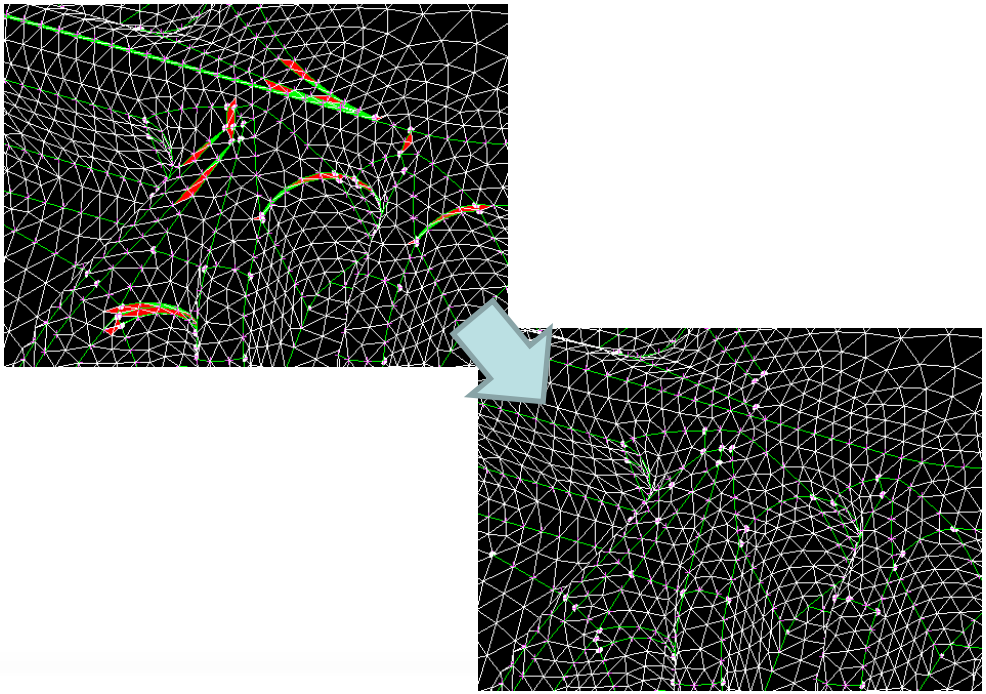


Surface meshing

Automatic Macro Area merging for high quality surface mesh

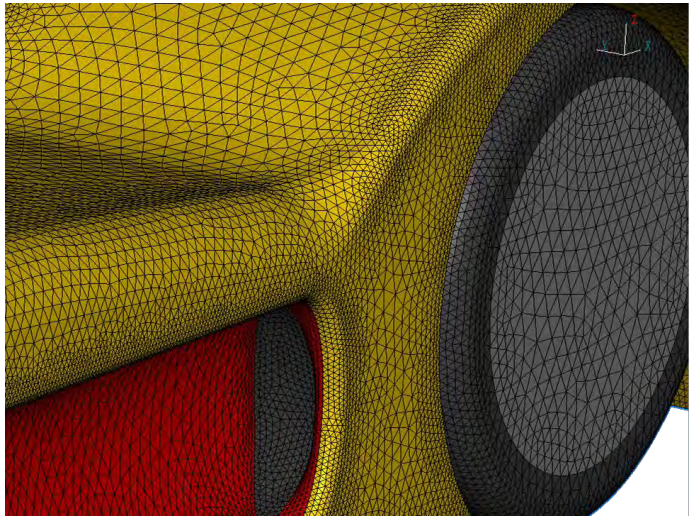


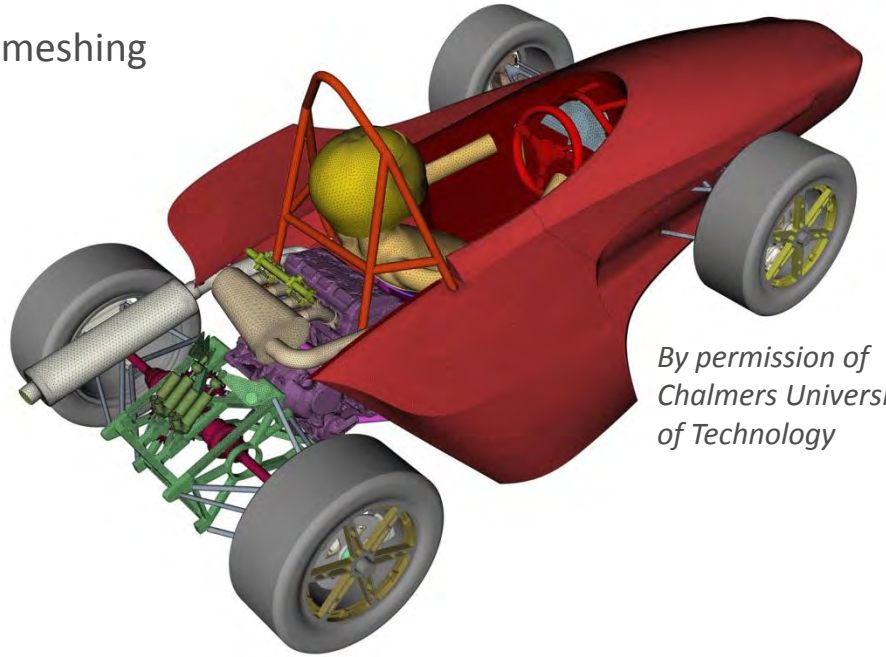




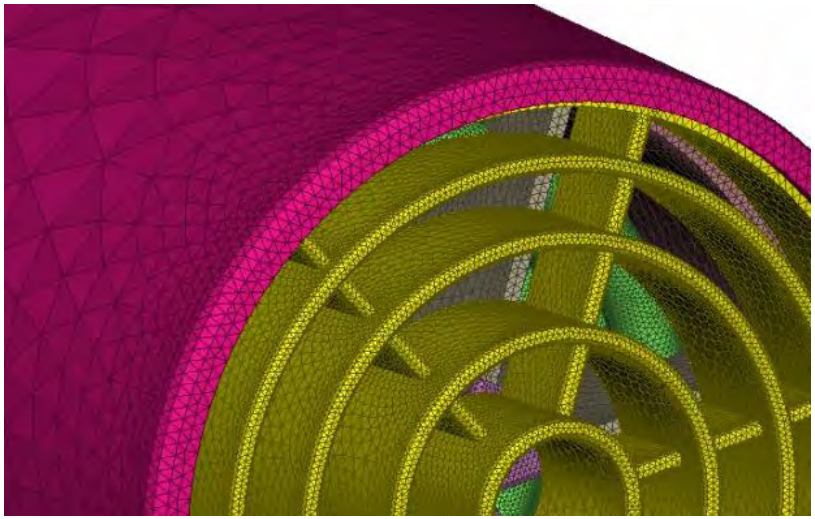
Surface meshing for CFD

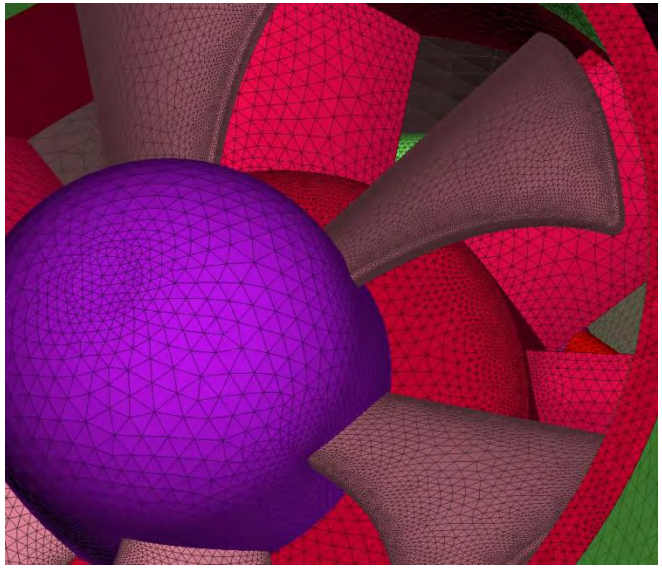
Fully automatic Curvature Dependent surface meshing with user controlled growth rate, min & max element size and mesh feature angle





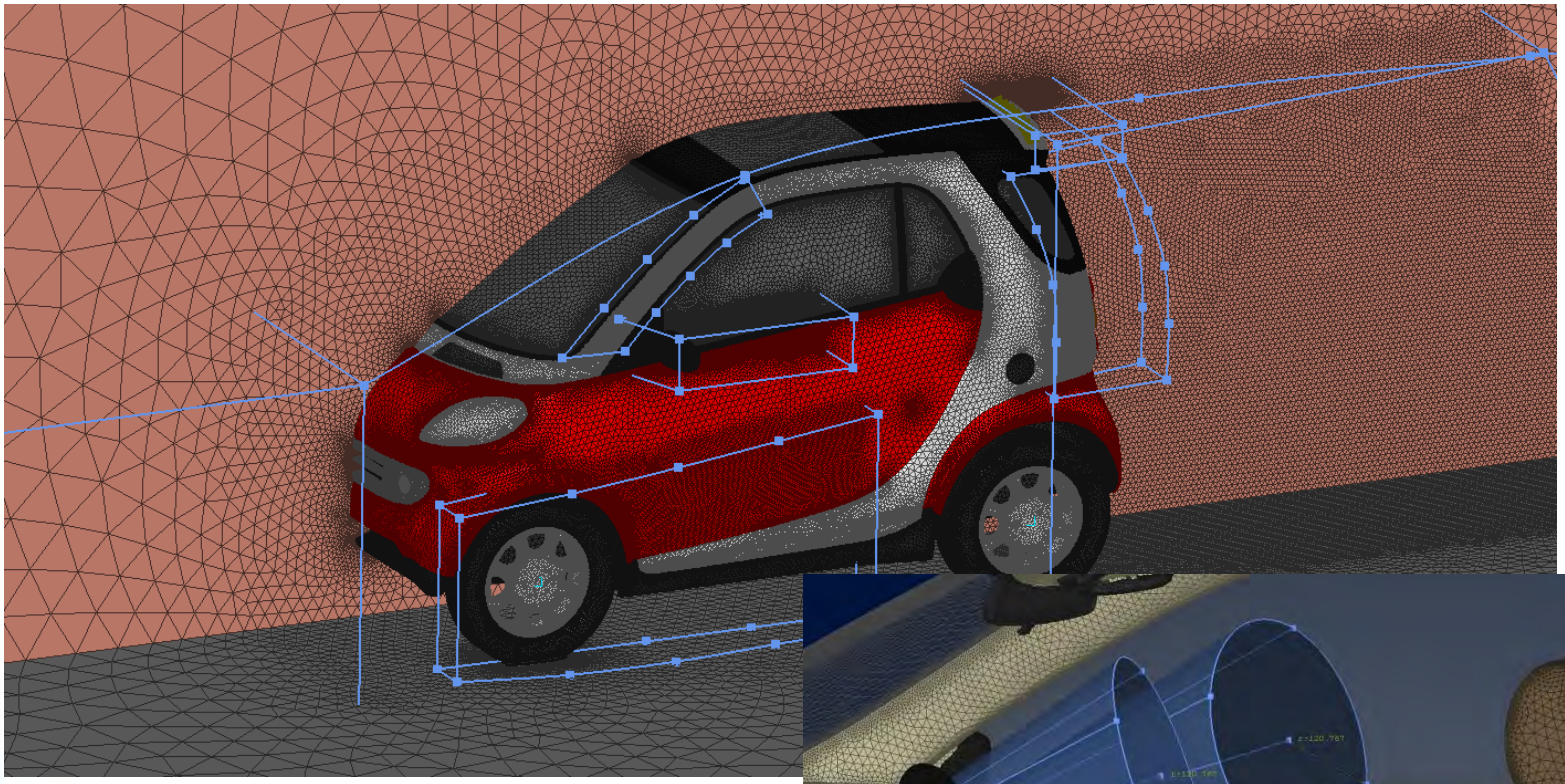
By permission of Chalmers University of Technology

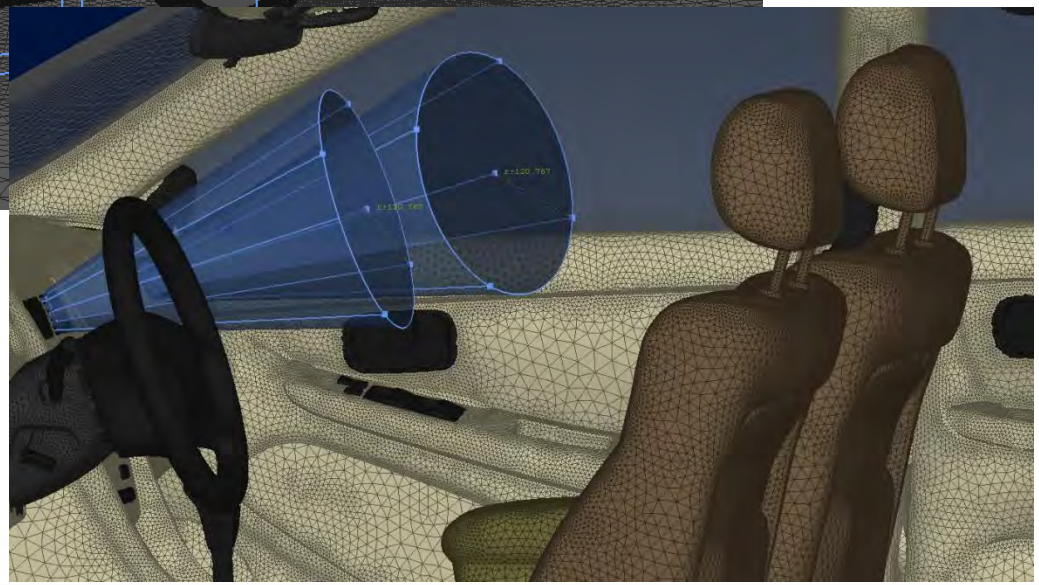




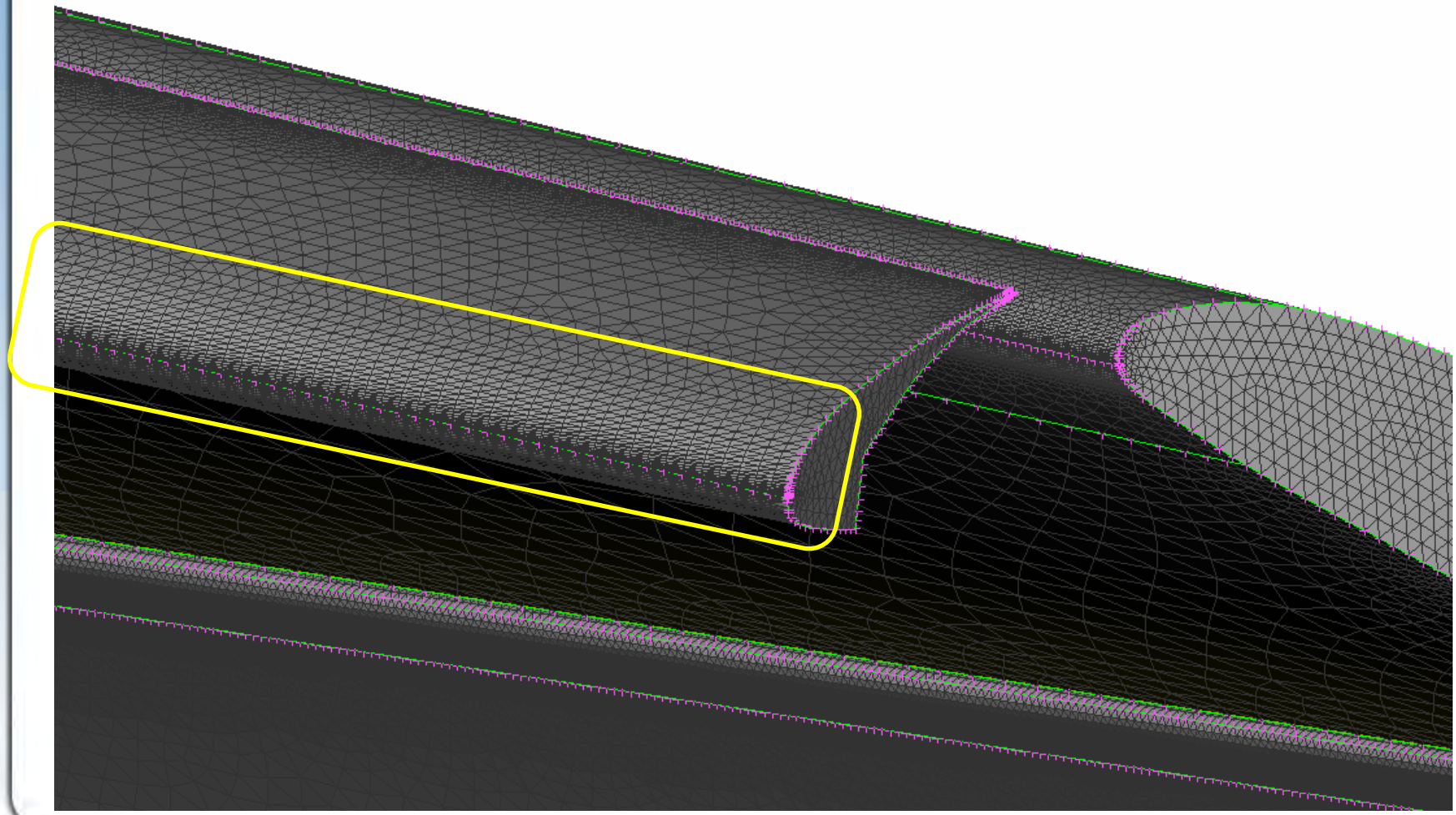
Surface meshing: Size Boxes

Size Boxes of arbitrary shape for local surface mesh control



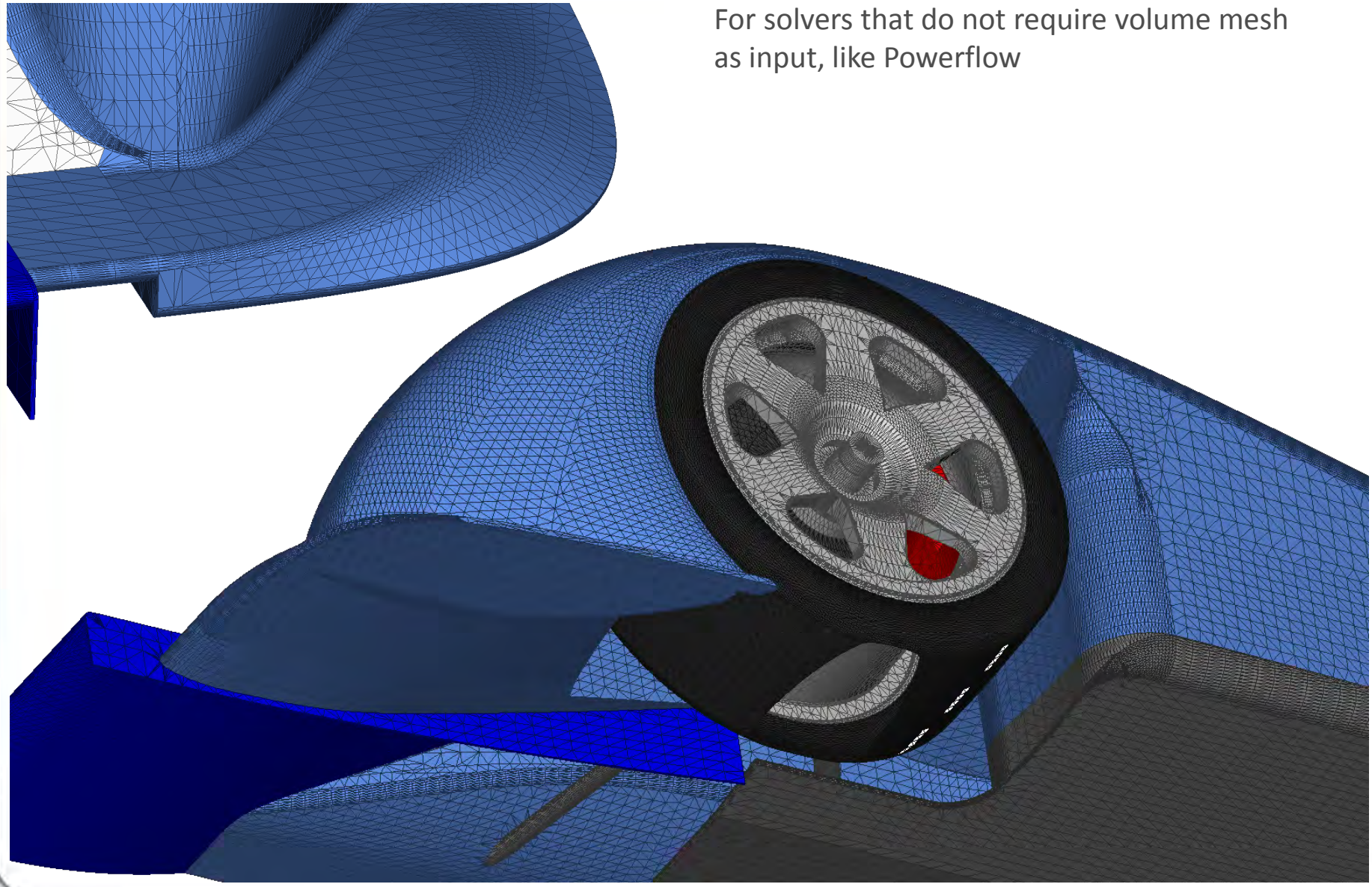


Combined CFD and anisotropic meshing for aerospace applications



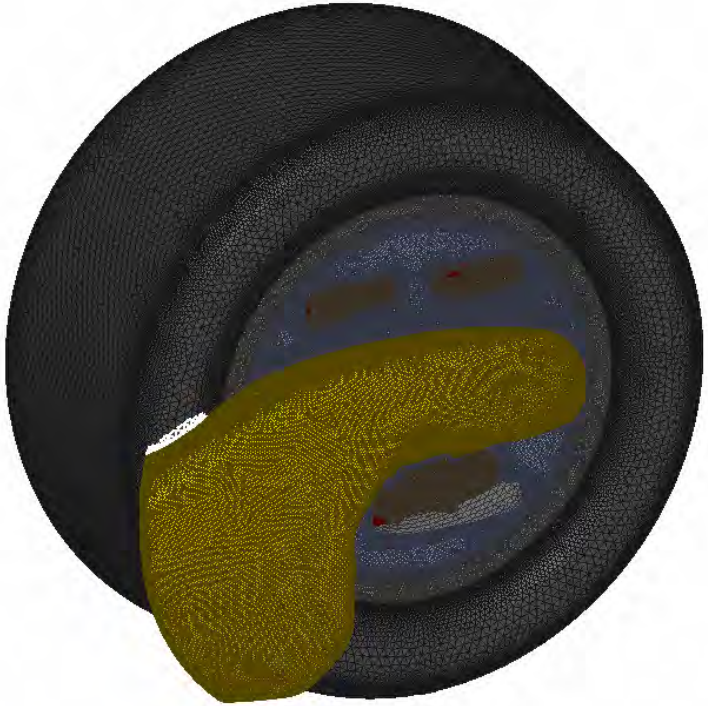
Surface meshing: STL algorithm

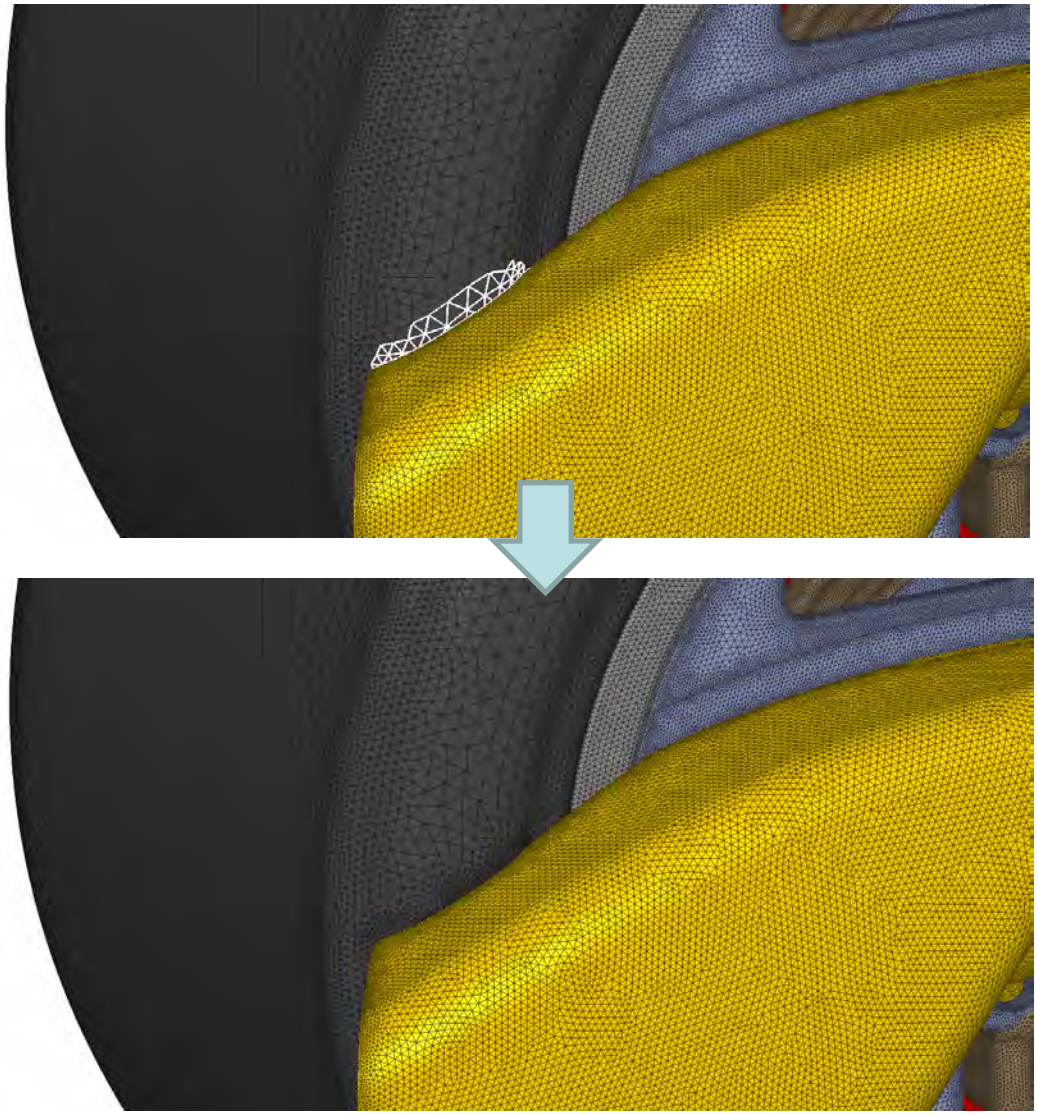
For solvers that do not require volume mesh as input, like Powerflow



Surface meshing – proximity detection

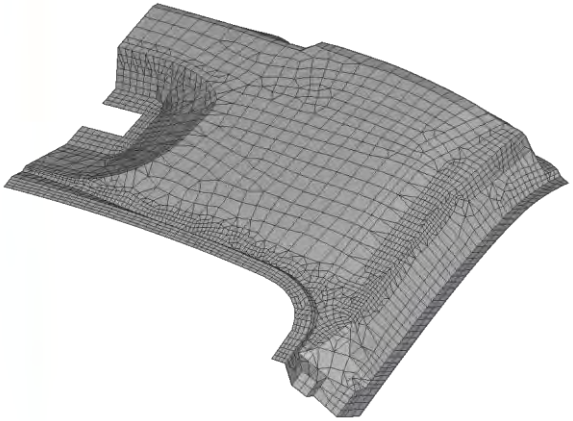
Proximity detection in shell mesh and auto-refinement

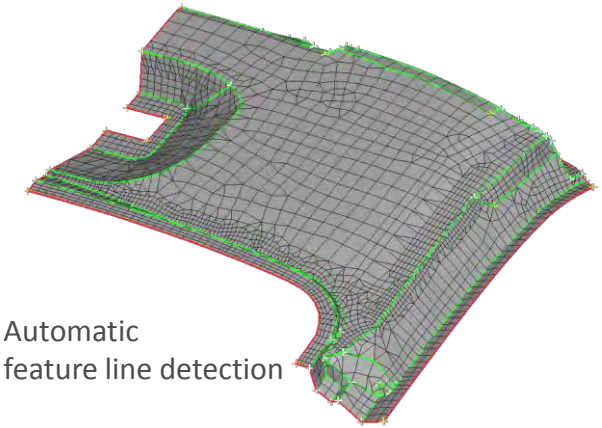




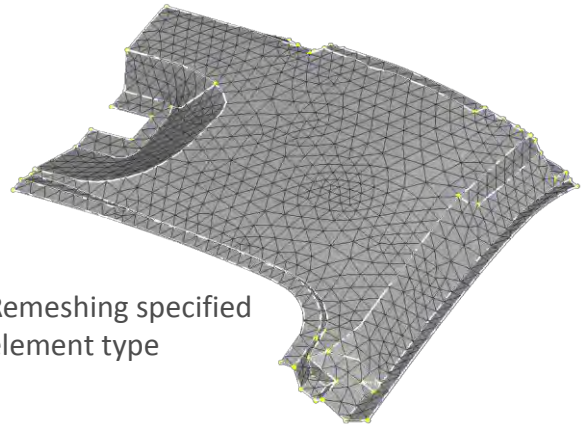
Surface meshing - Reconstruction

Reconstruction of existing FE-model mesh for element type modification, quality improvement, refinement, or coarsening

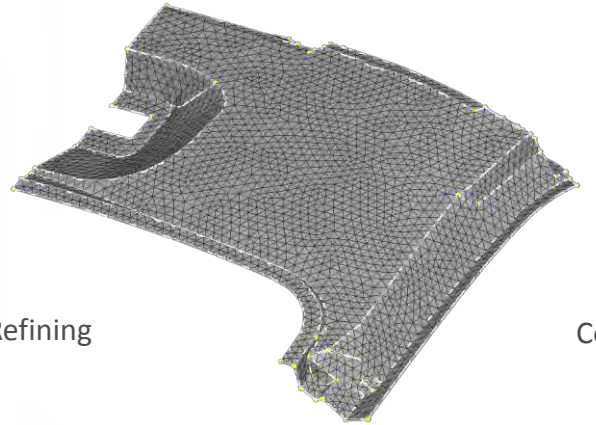




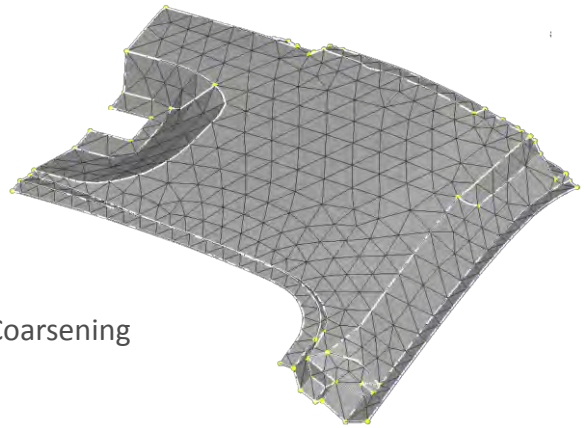
Automatic
feature line detection



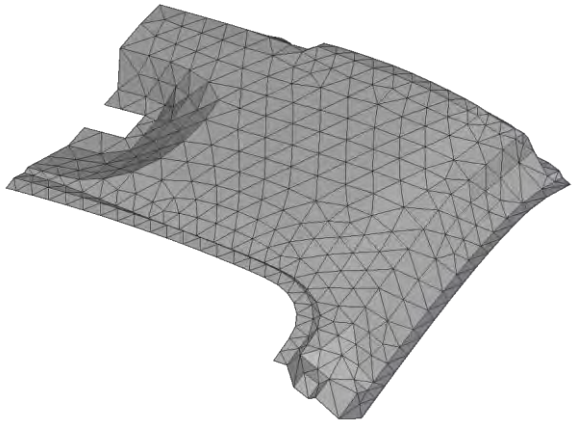
Remeshing specified
element type



Refining

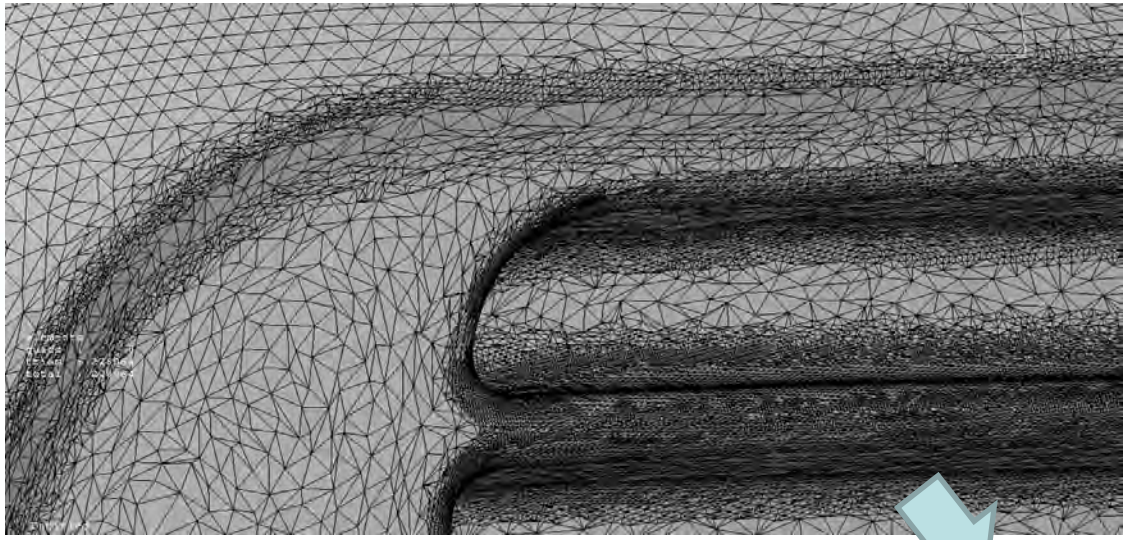


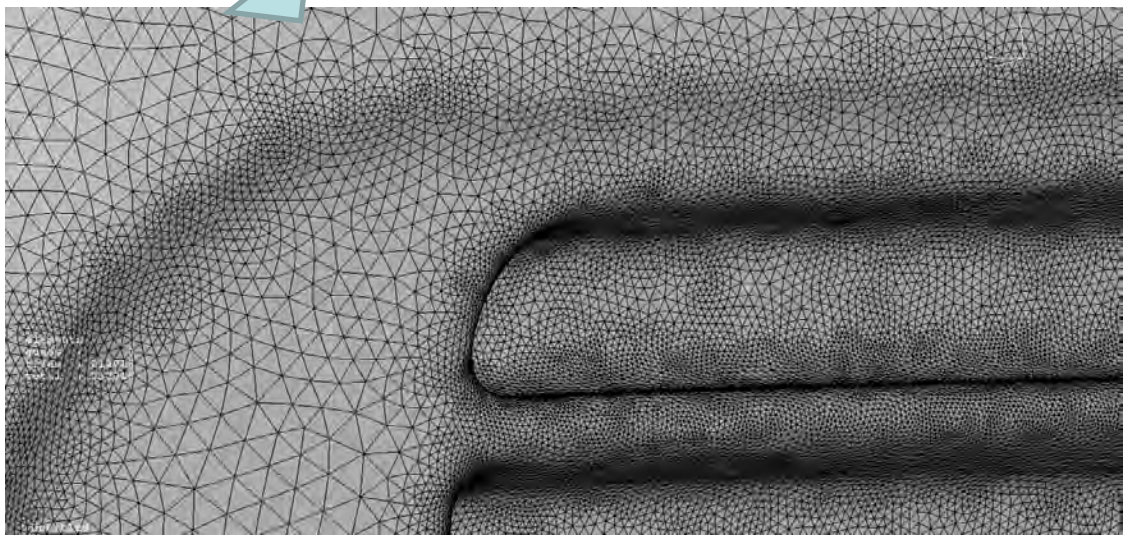
Coarsening



Surface meshing - Reconstruction

Reconstruction of bad quality STL mesh respecting local size and curvature

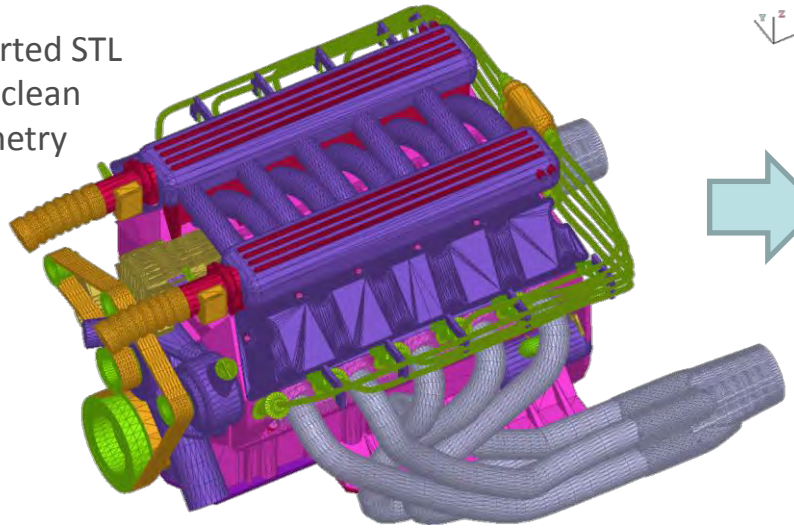




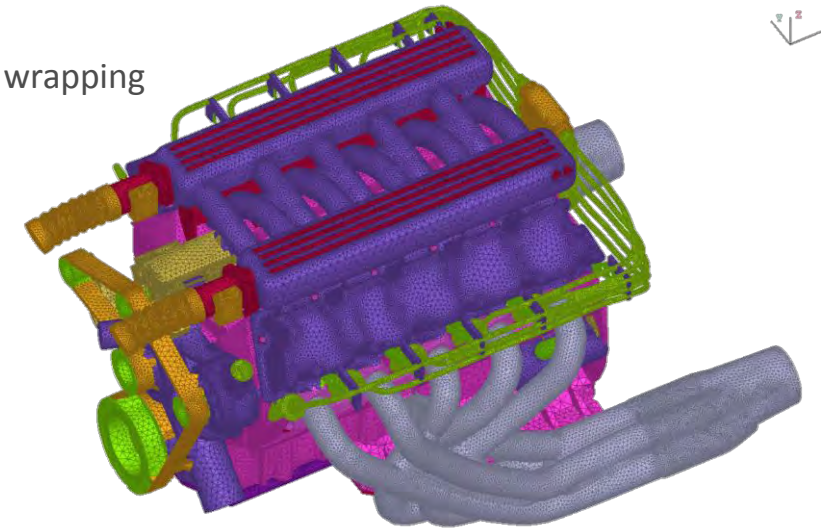
Surface Wrapping

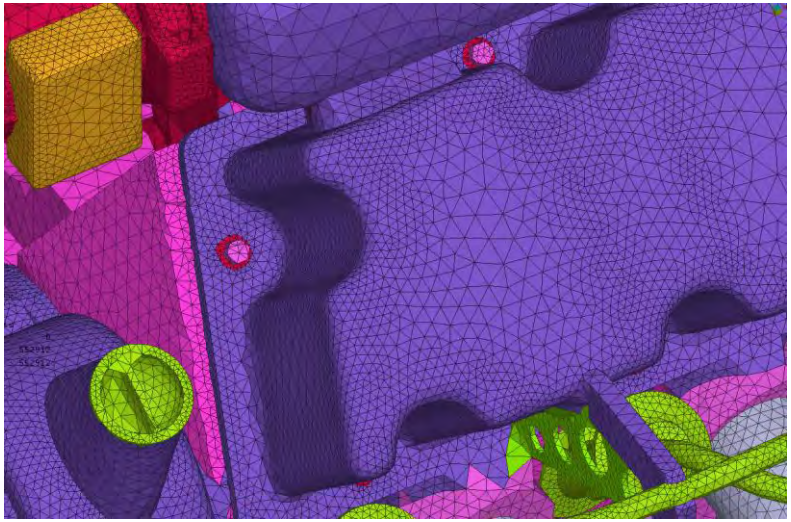
Variable length Wrapping, capturing local curvature and model feature lines

Imported STL or unclean geometry



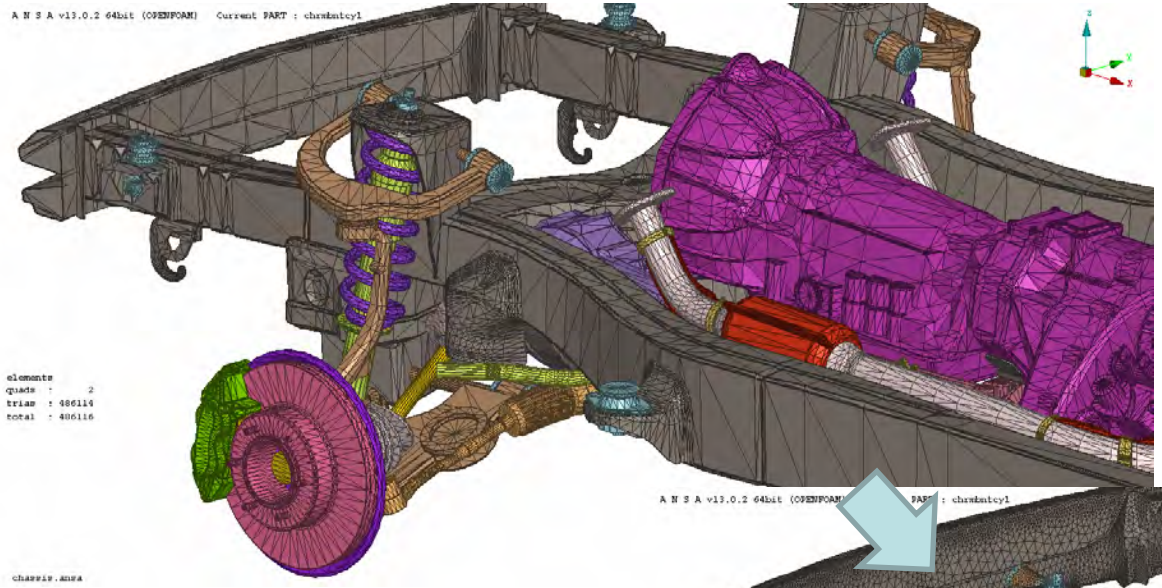
wrapping



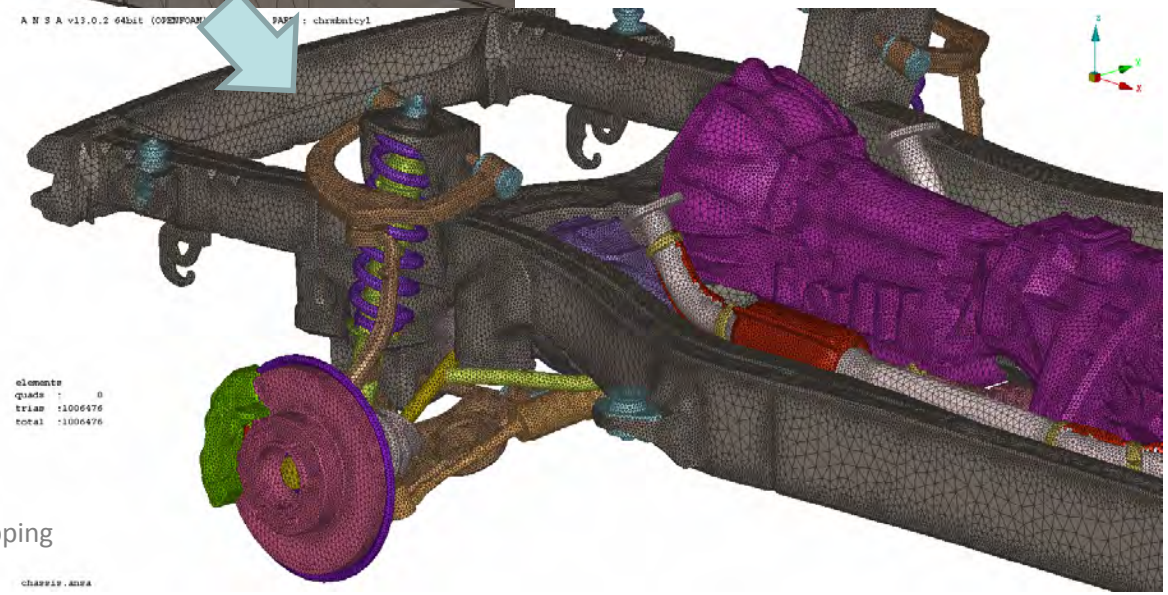


Surface Wrapping

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



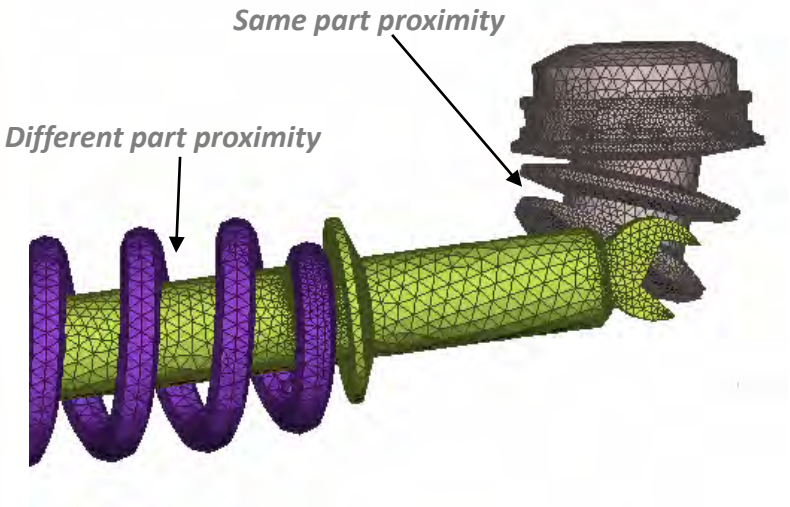
Input STL data
Treatment (hole and gap closure)

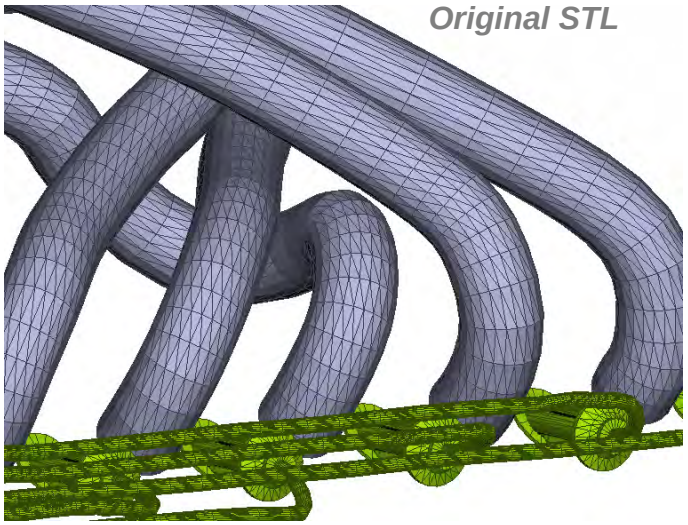


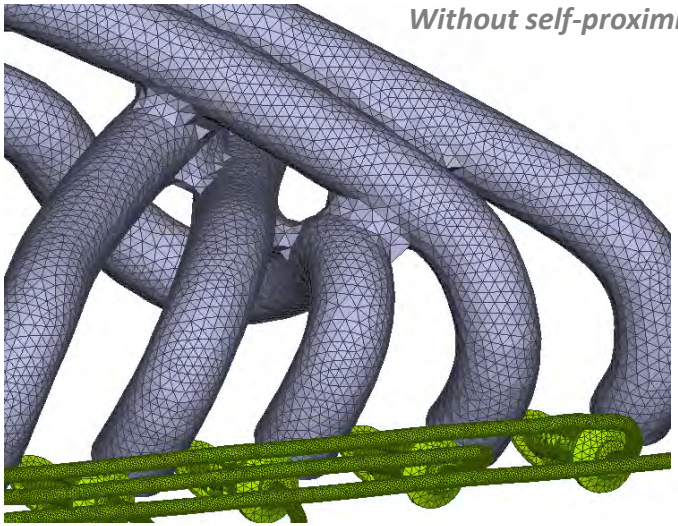
Surface Wrapping

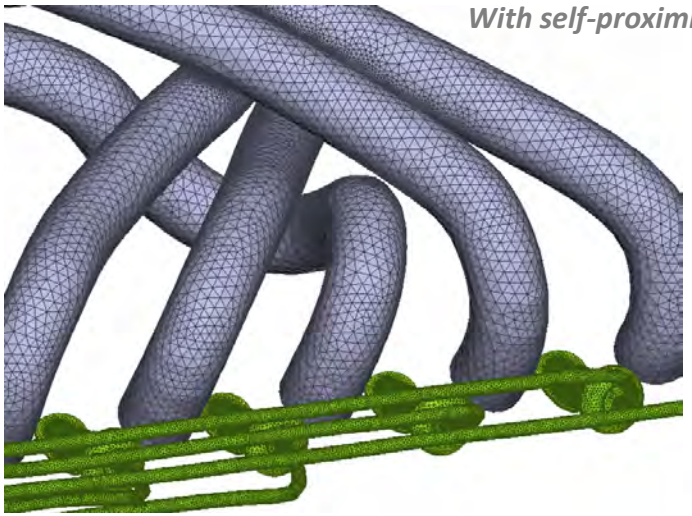
Surface Wrapping: proximity refinement options

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

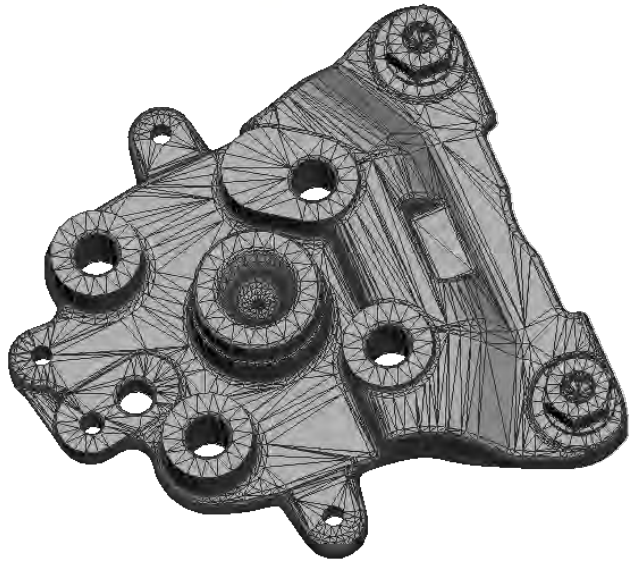


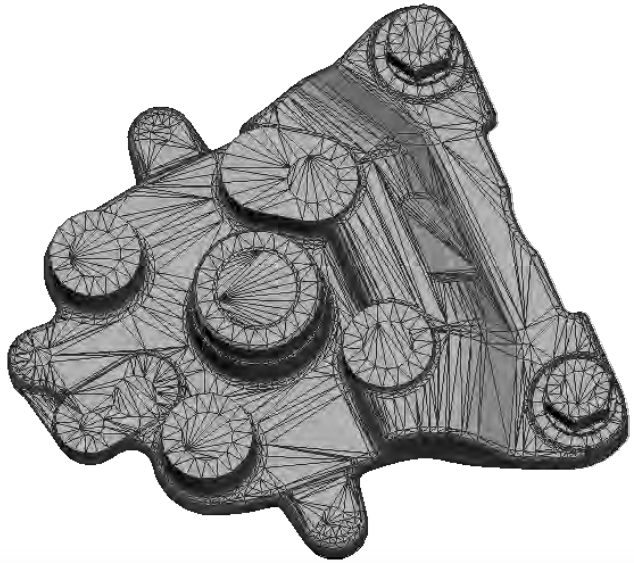






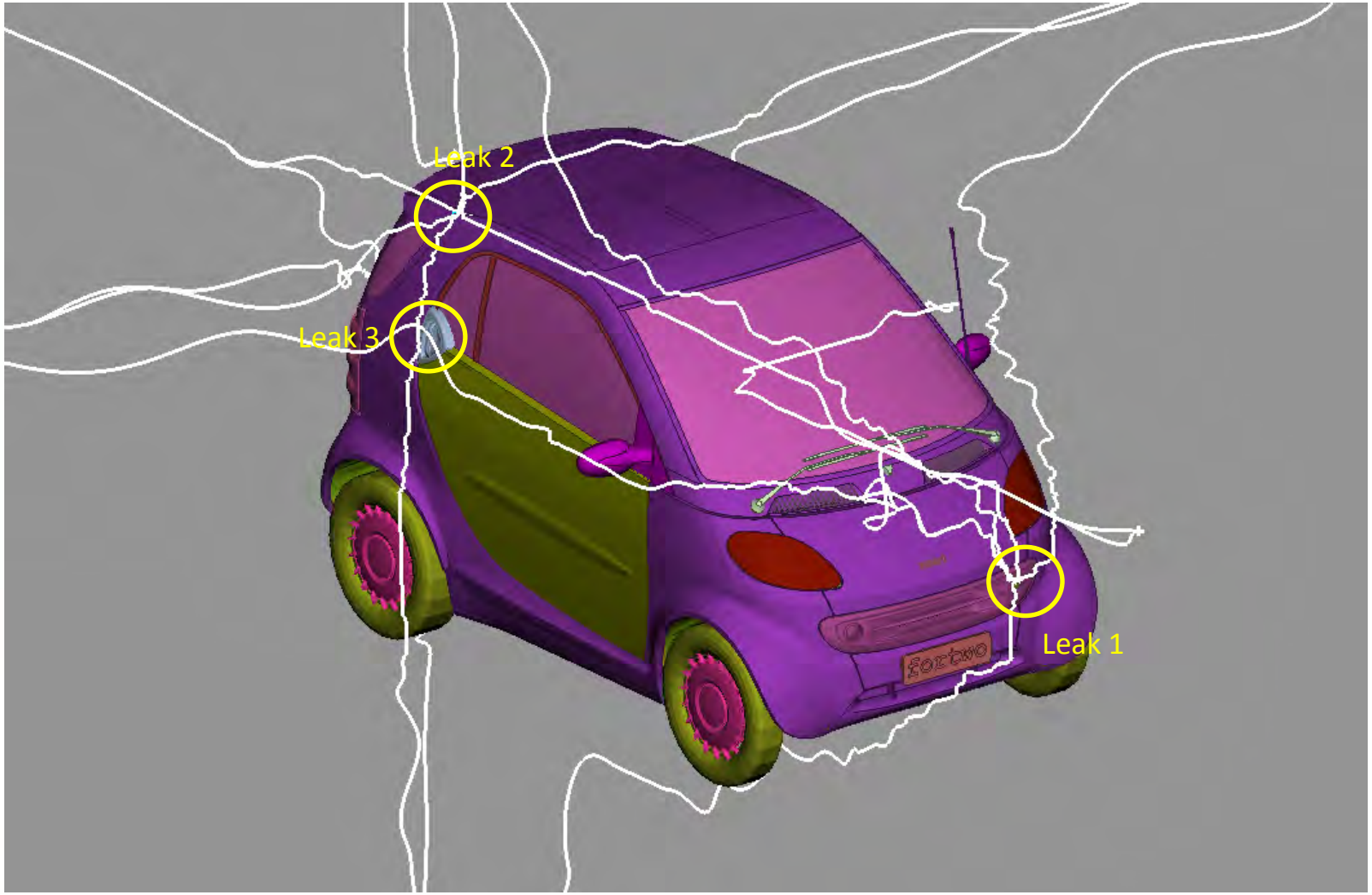
Automatic detection and removal of gaps and features



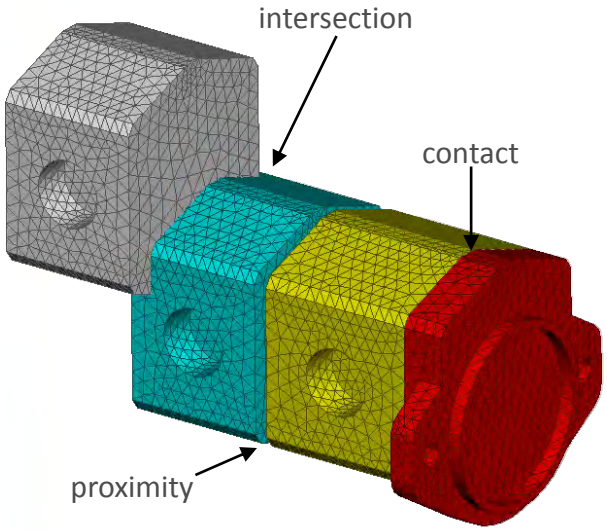


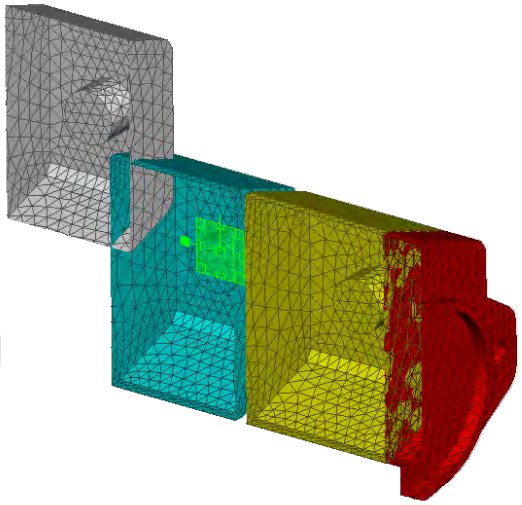
Surface Wrapping: leak detection tools

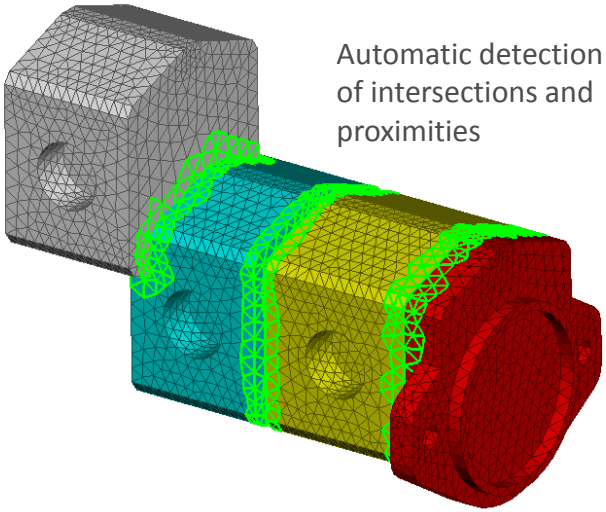
Identification of multiple leak paths for multiple user specified source points

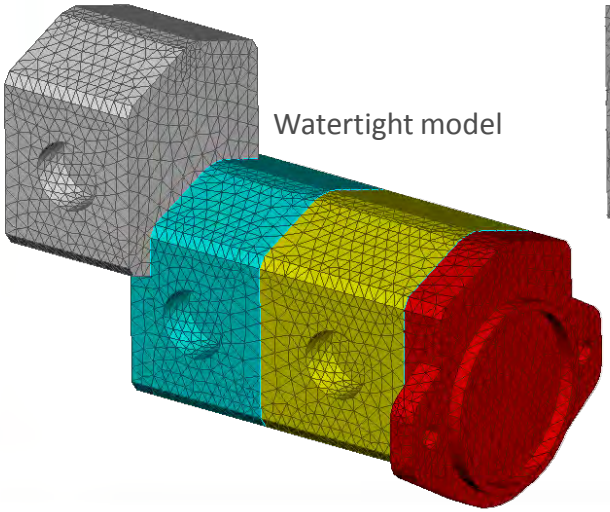


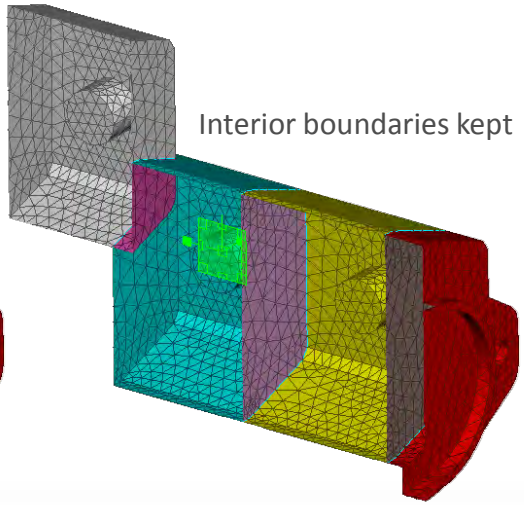
Watertight model creation for intersections, contacts and proximities

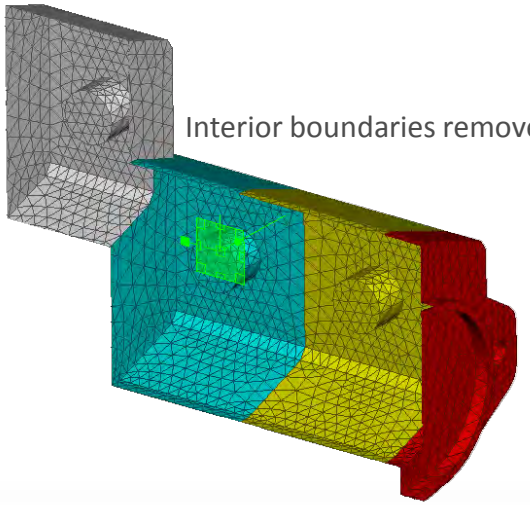




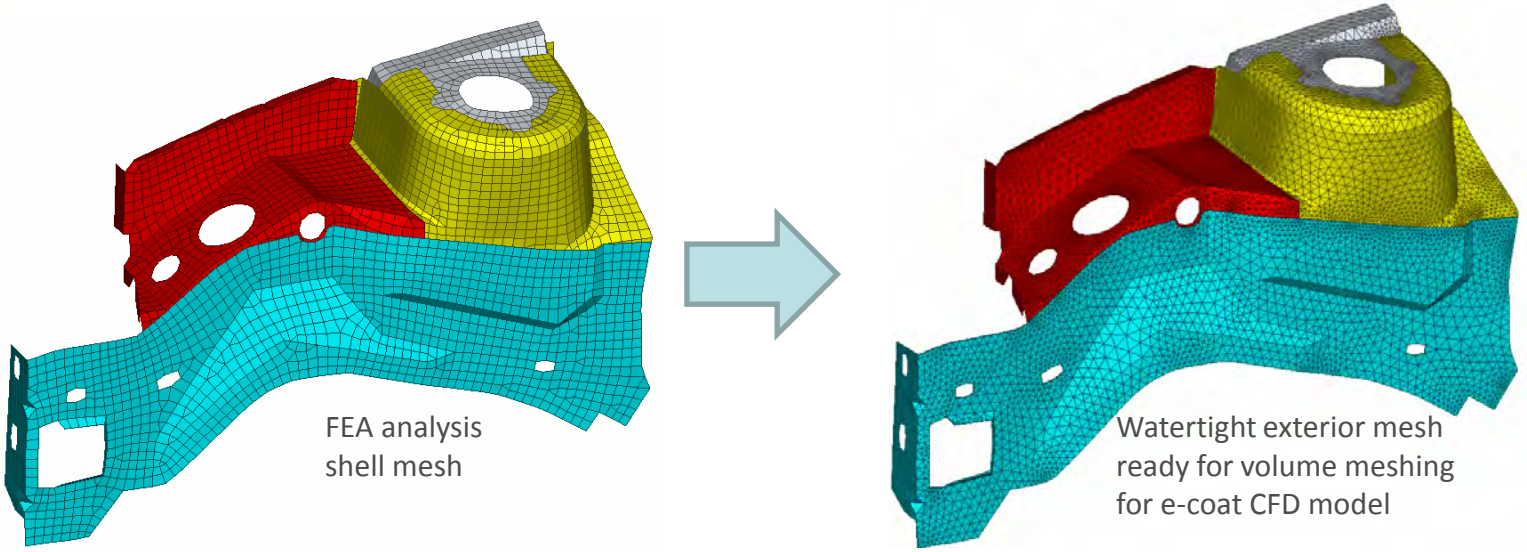


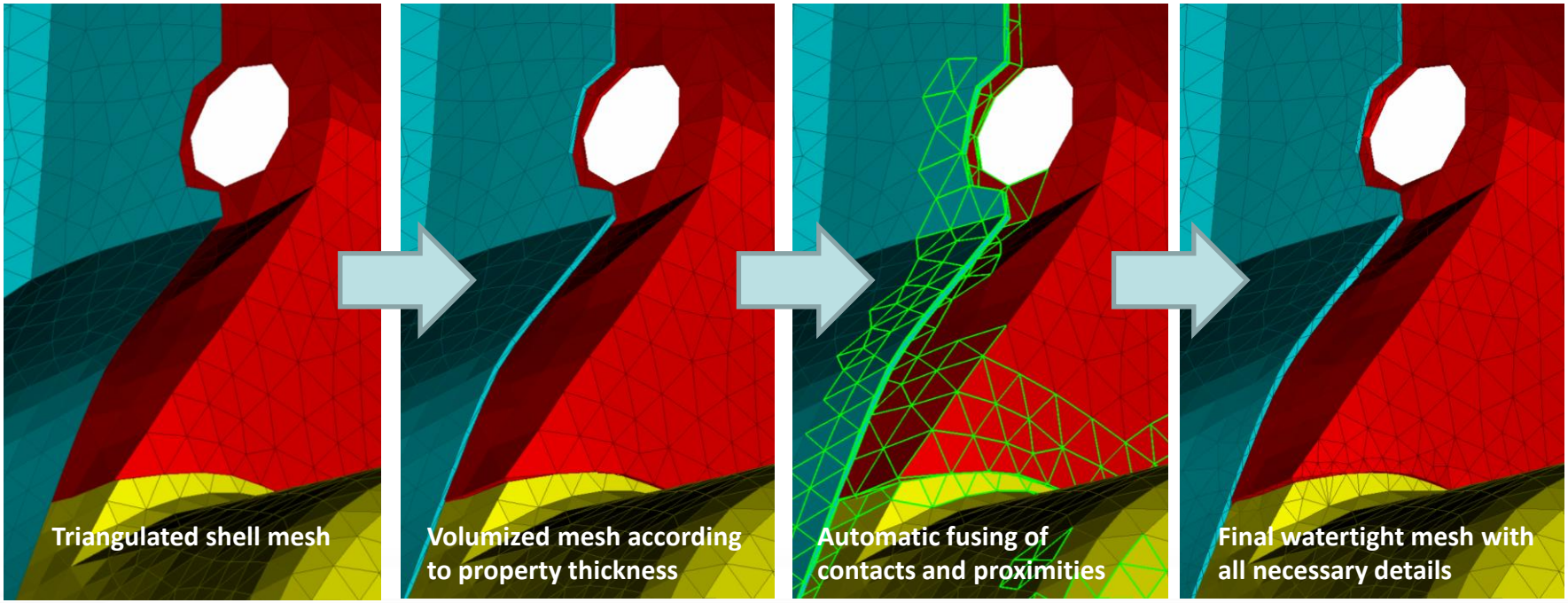






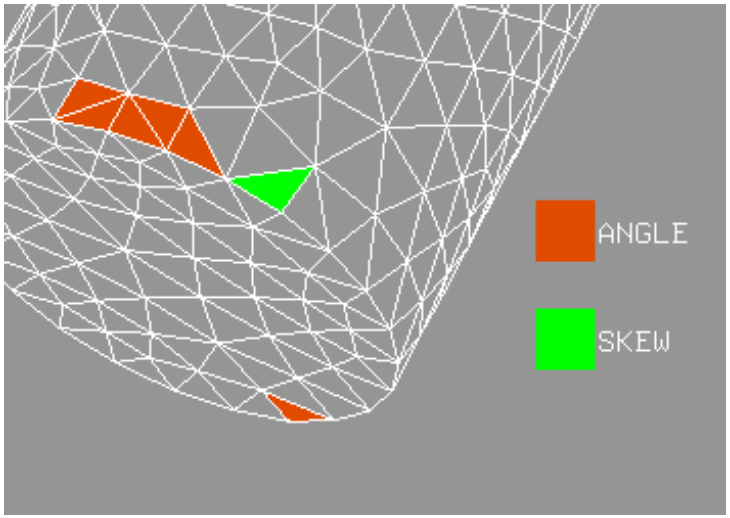
Efficient creation of models for e-coat simulations starting from FEA meshes





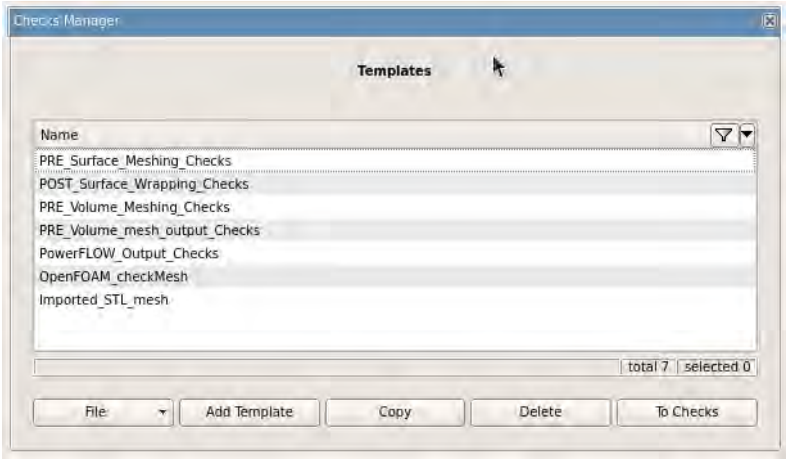
Surface meshing: Checks

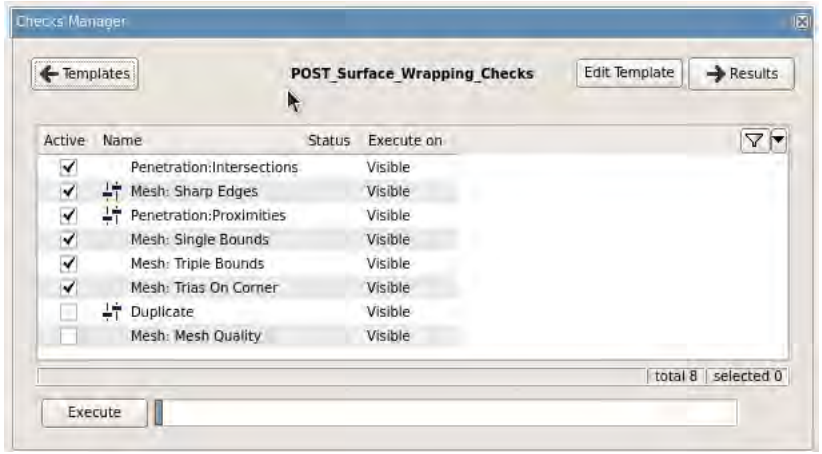
Quality check according to
multiple criteria (skewness, angle
squish, length, aspect, warp, etc.)
and solvers (Fluent, Star, OpenFOAM etc.)



Clear identification of poor-quality elements

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

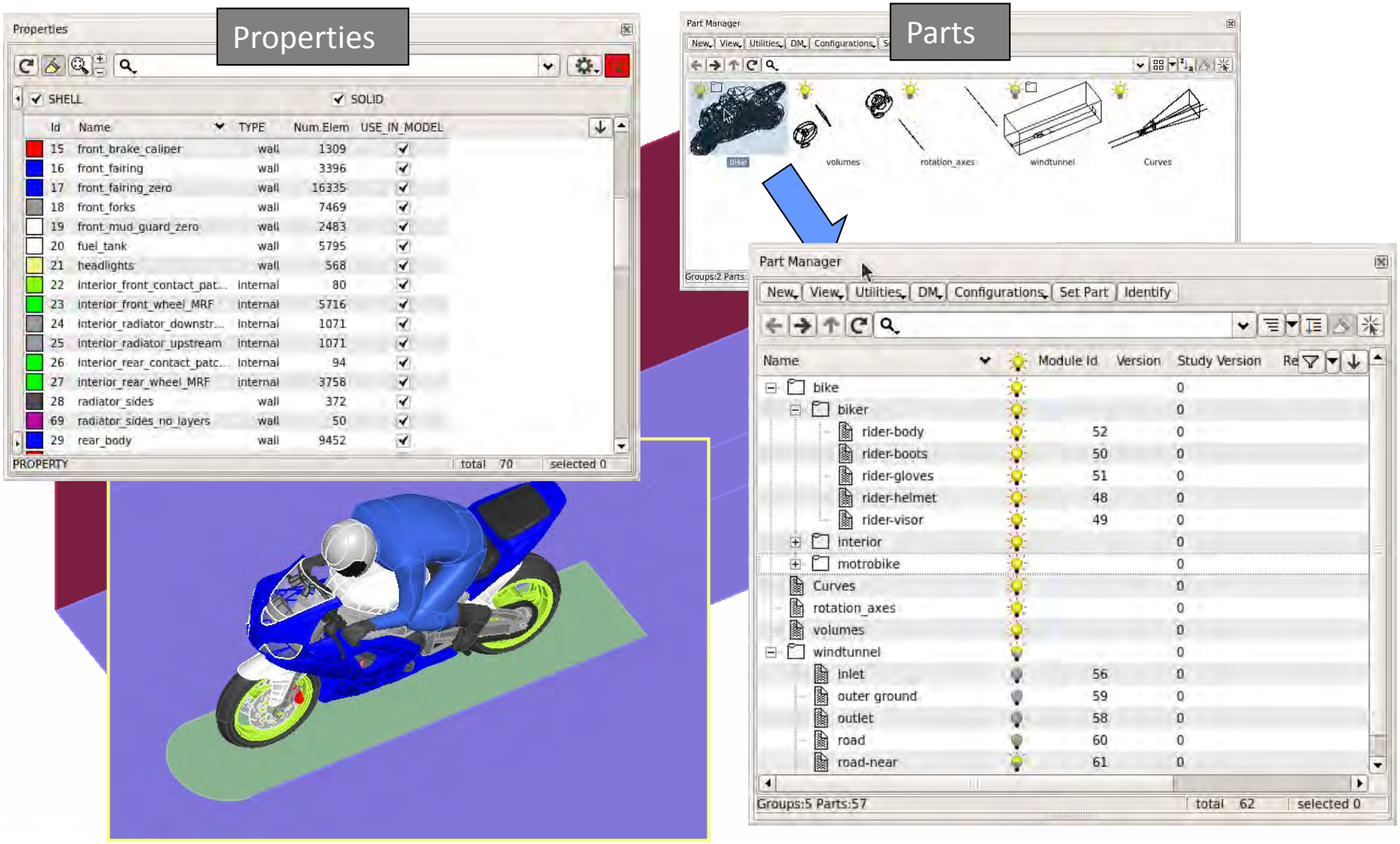




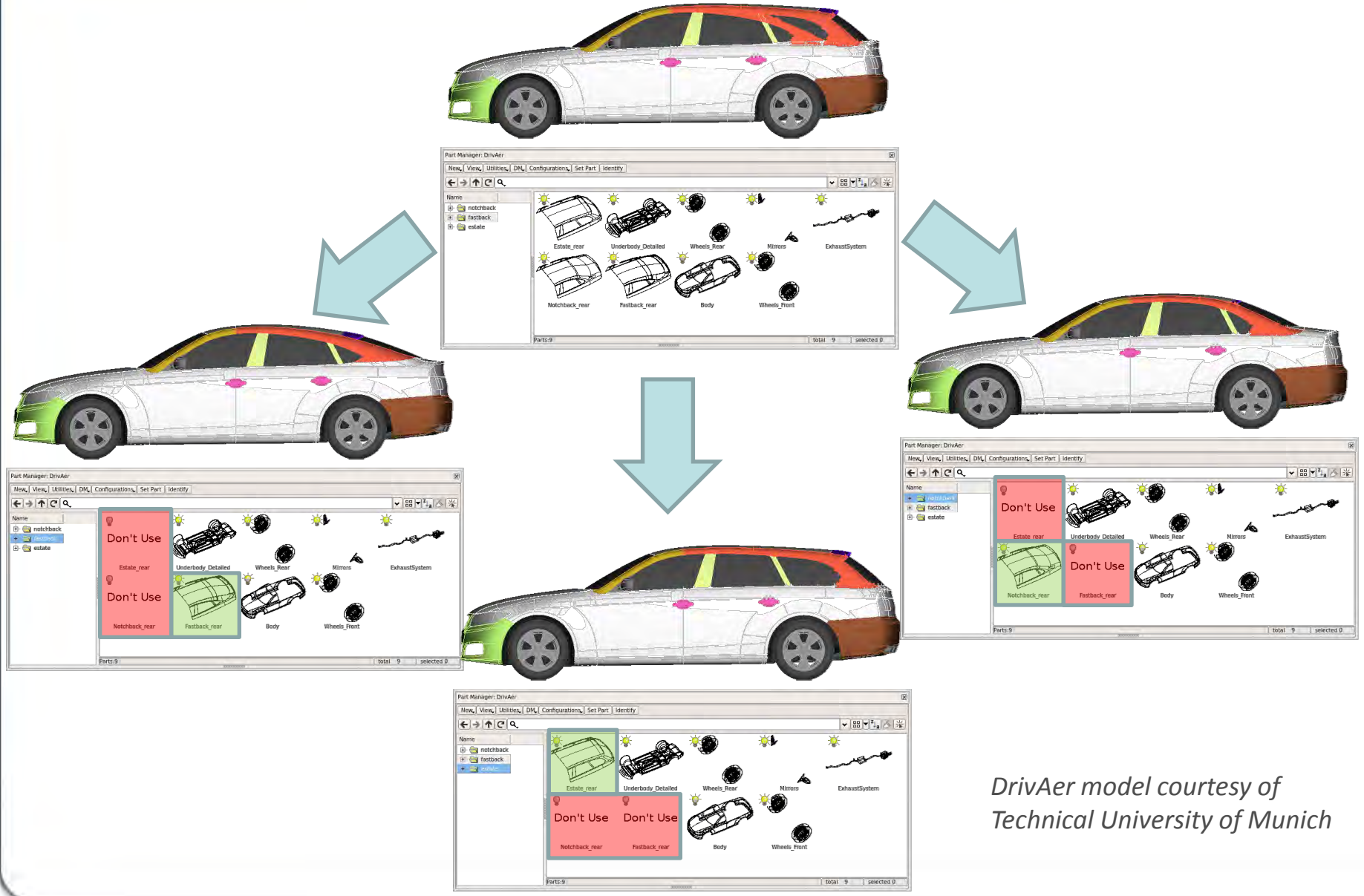
Comprehensive mesh information and quality statistics

CFD model management

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



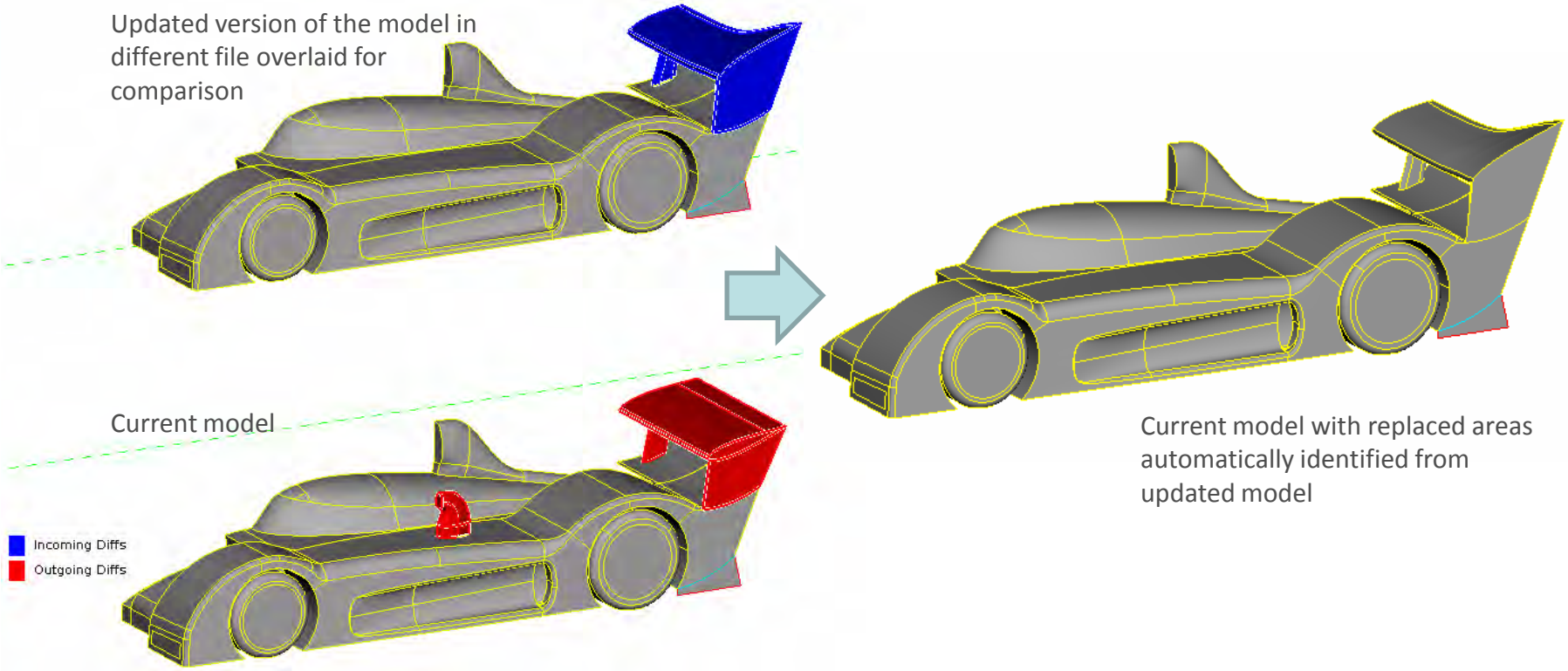
Configurations Management functionality handling three variants in one file



DrivAer model courtesy of Technical University of Munich

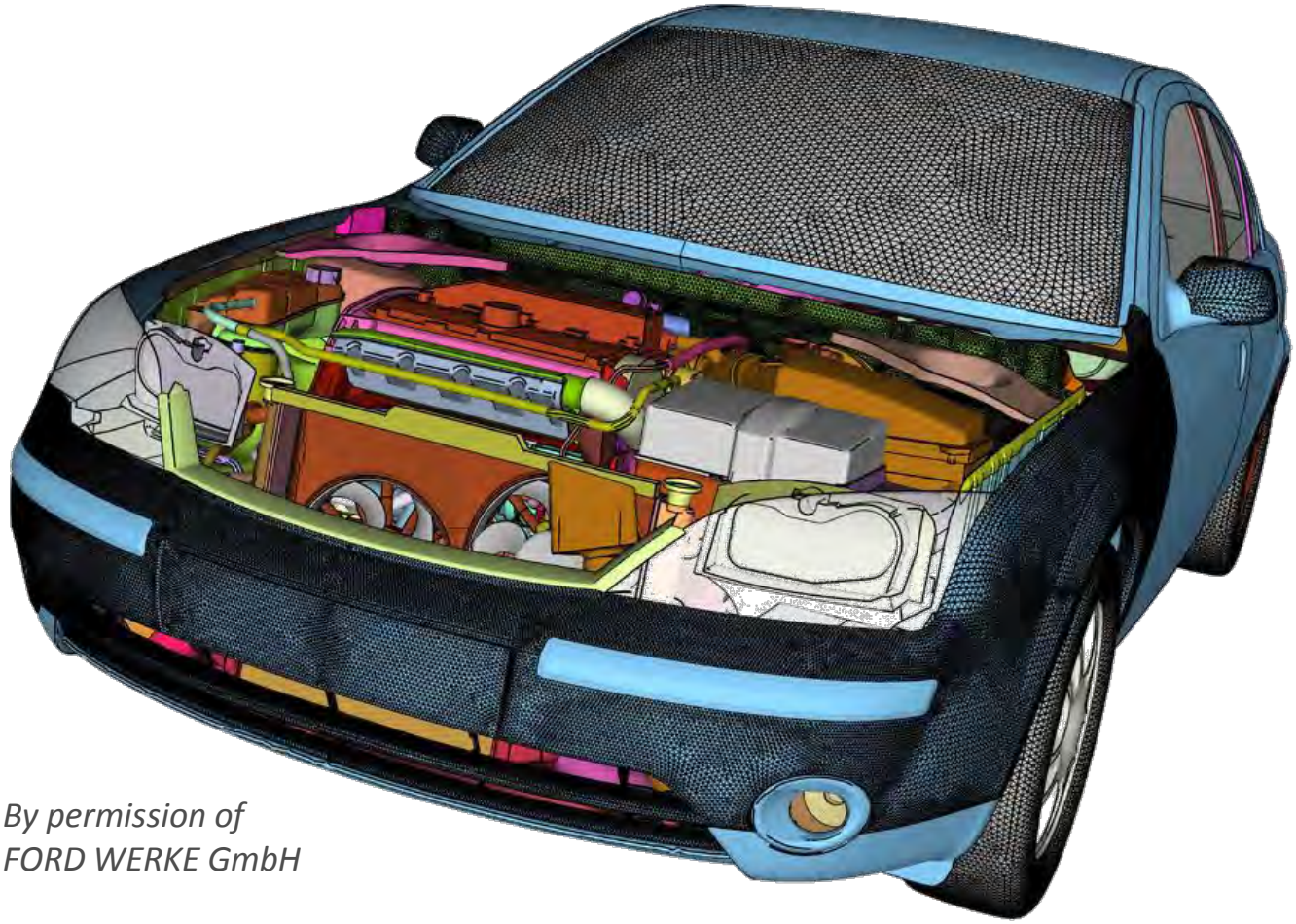
CFD model management

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

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



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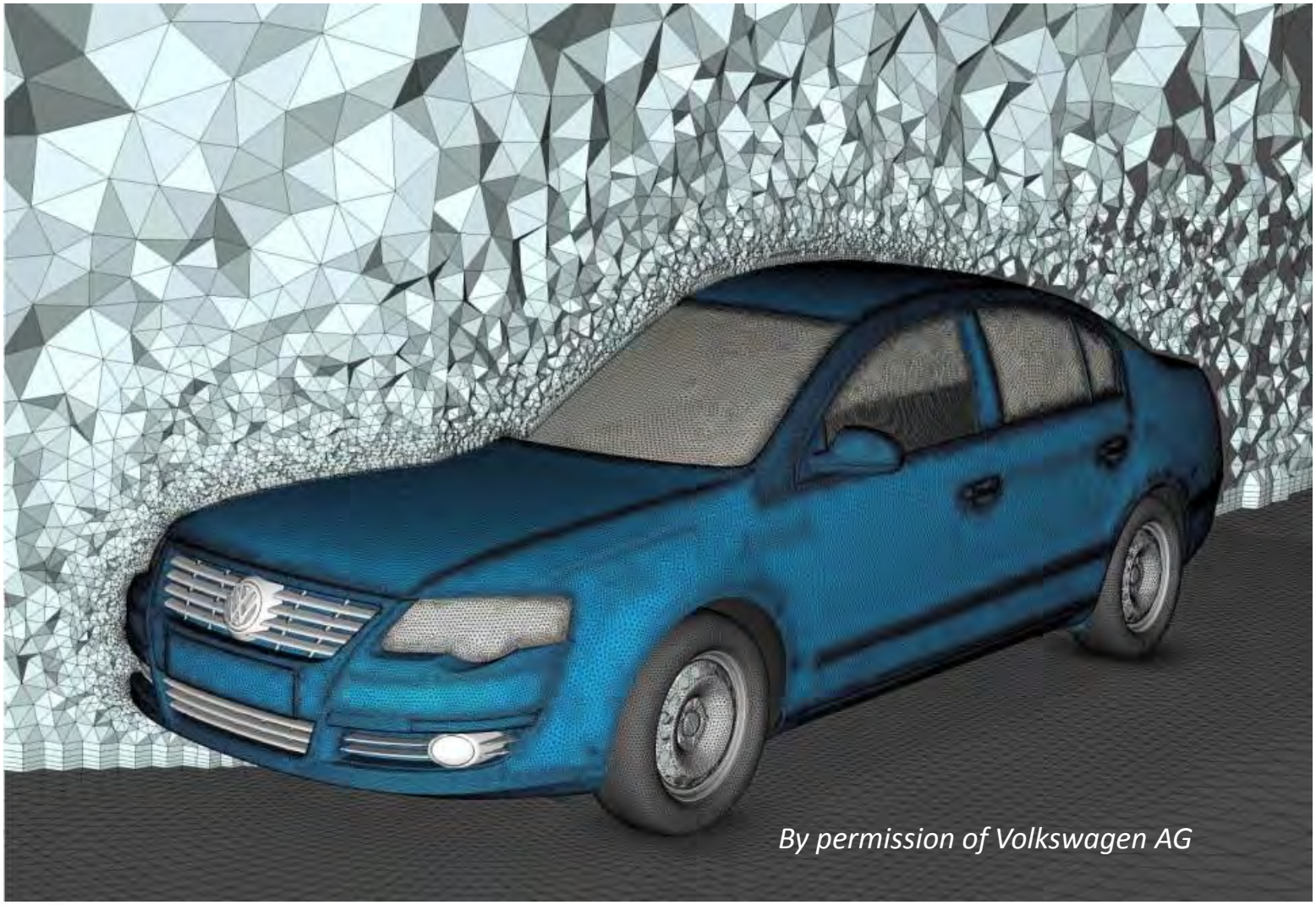
FORD WERKE GmbH

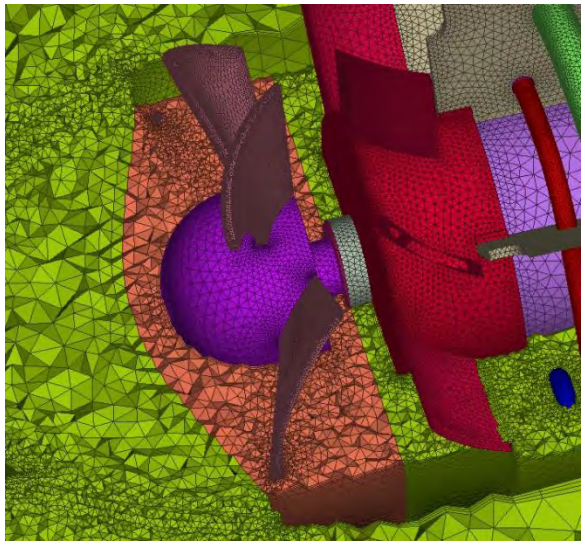
Volume meshing

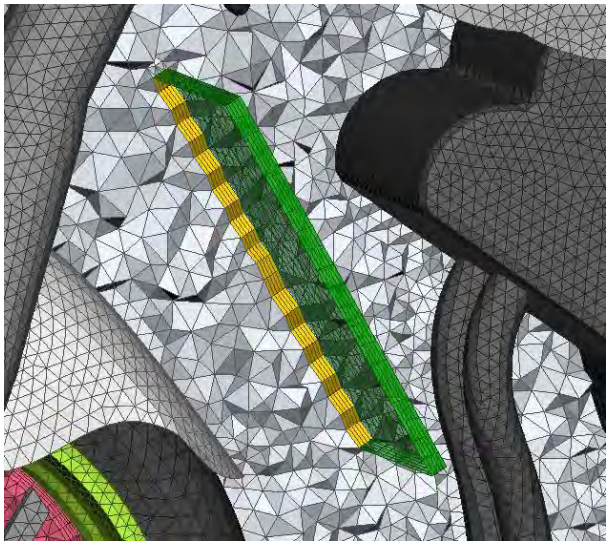
Fast and robust volume meshing for all types of elements
(tetra, pyramid, prism, hexa and polyhedron)

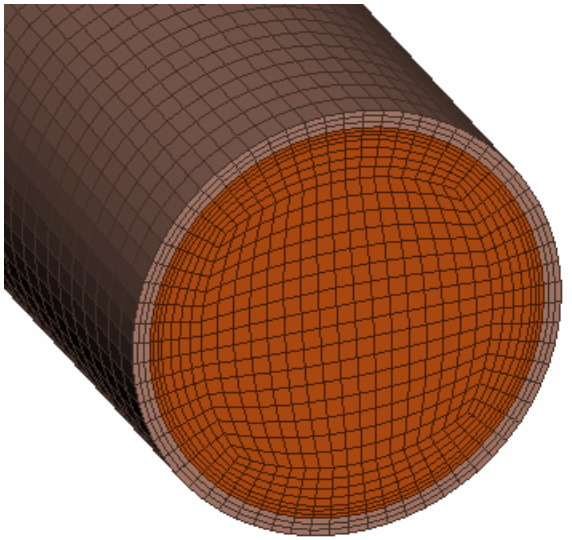


Volume meshing: Definition of multiple fluid and solid zones

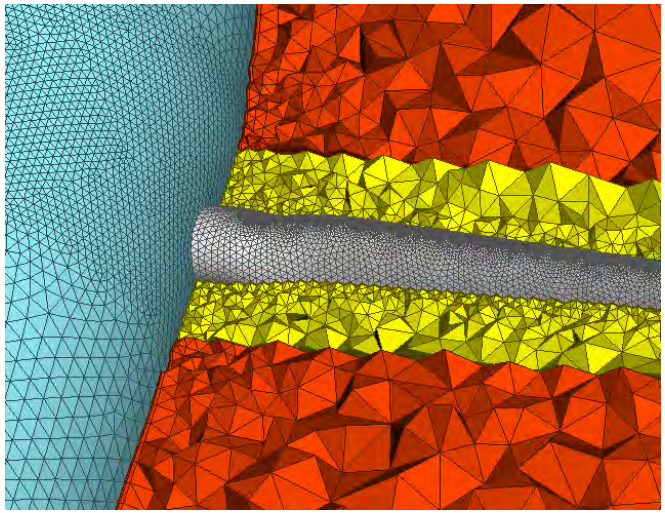
Conformal mesh for MRF and porous zones and for conjugate heat transfer analyses



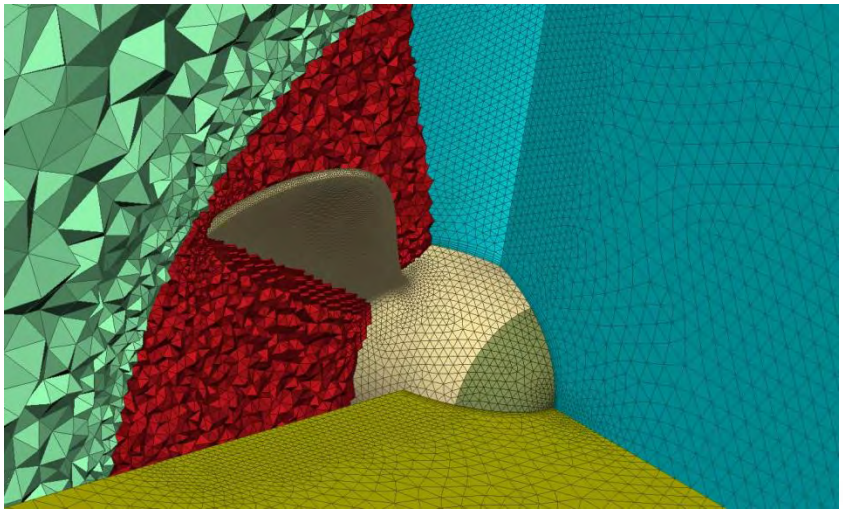




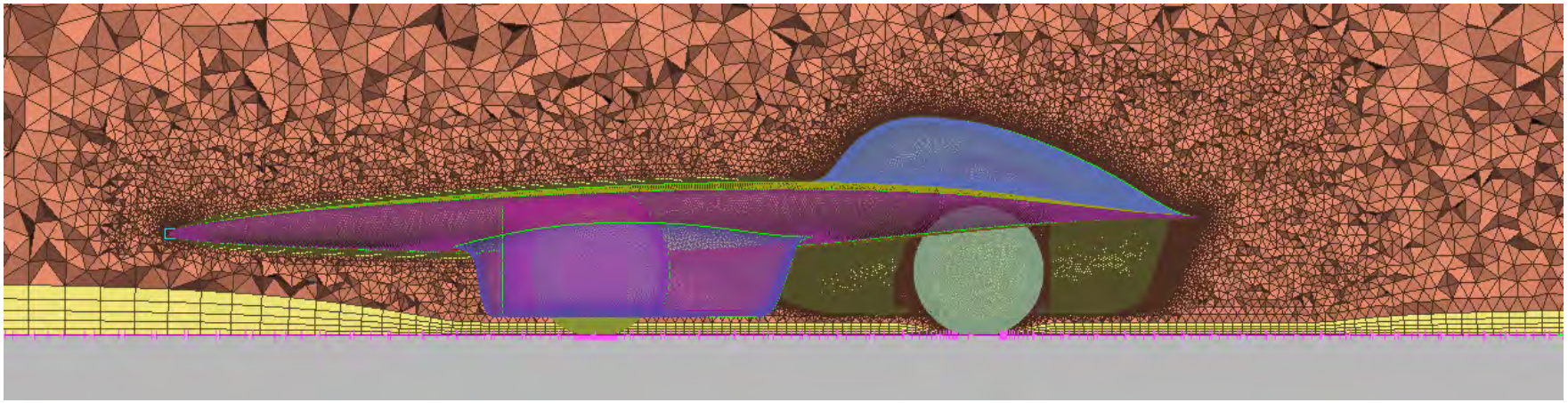
Non-conformal mesh for moving mesh analysis

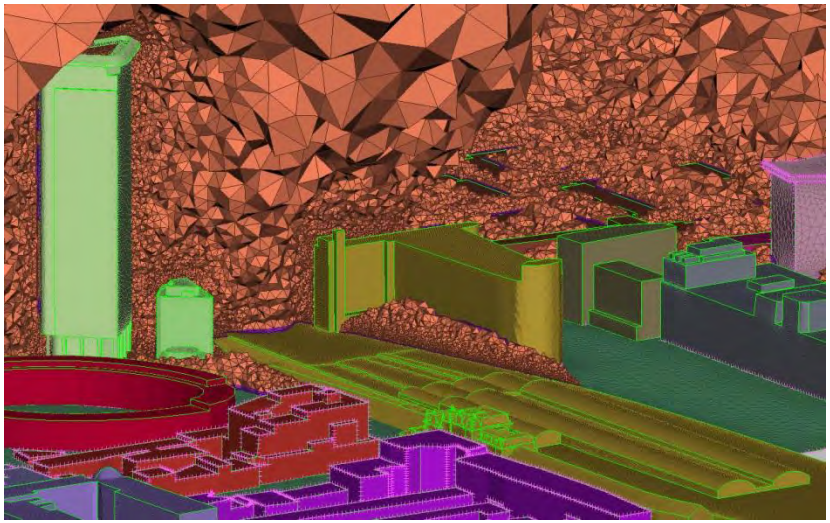


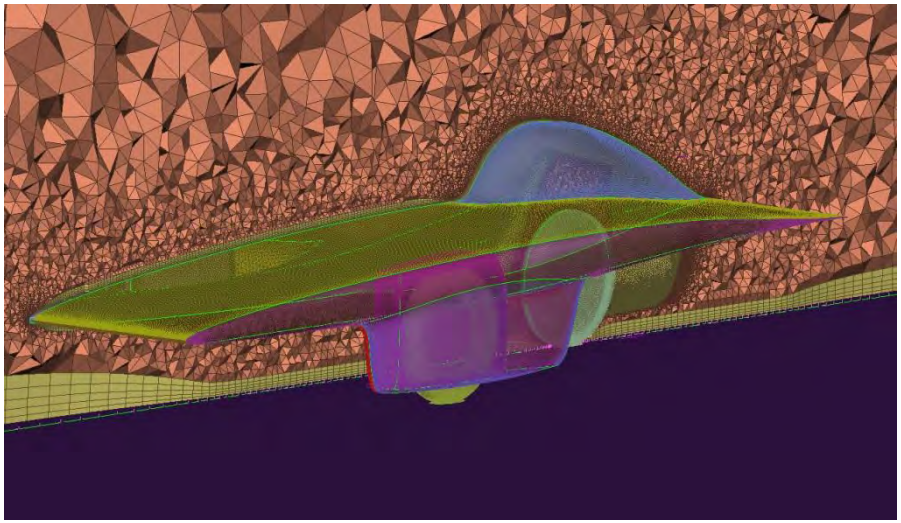
Periodic BCs matching node meshes



Volume meshing: Solar car and urban environment CFD simulations

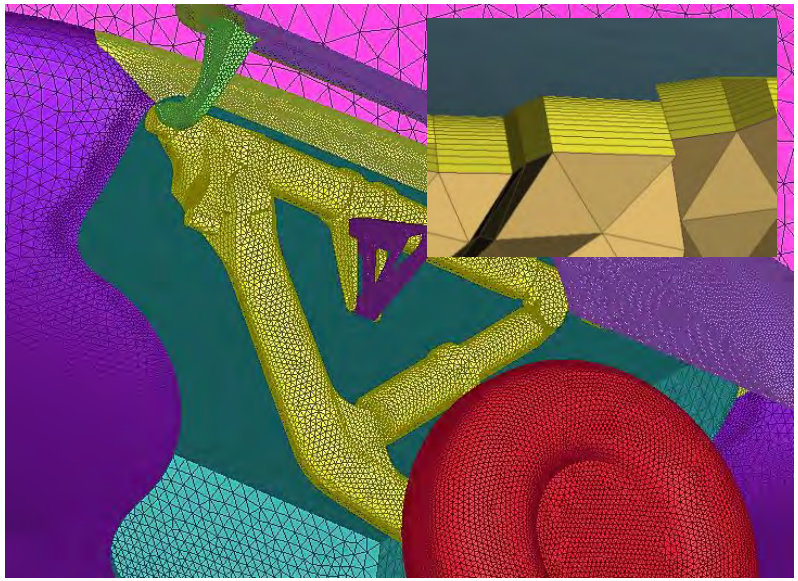


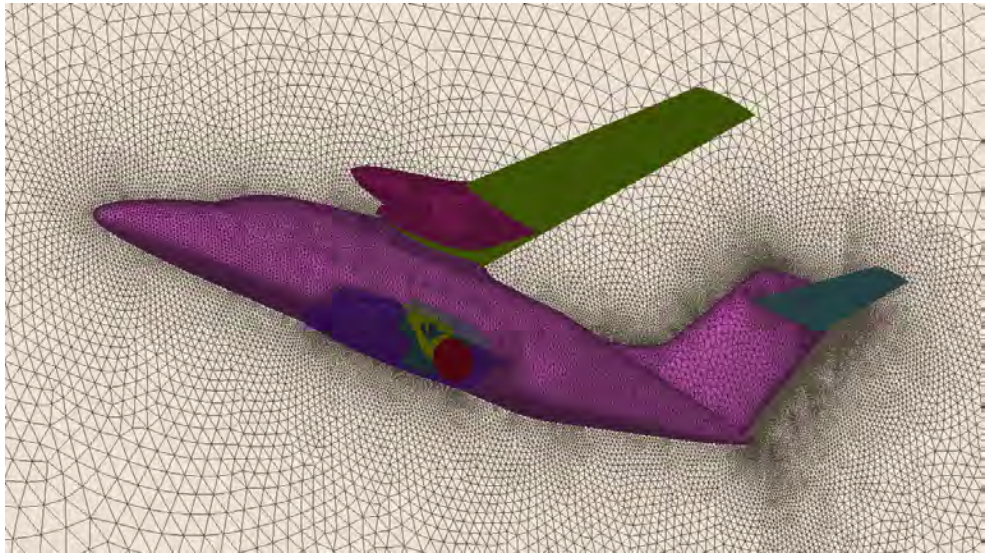




Courtesy of Actiflow BV

Volume meshing: EV-55 outback CFD study

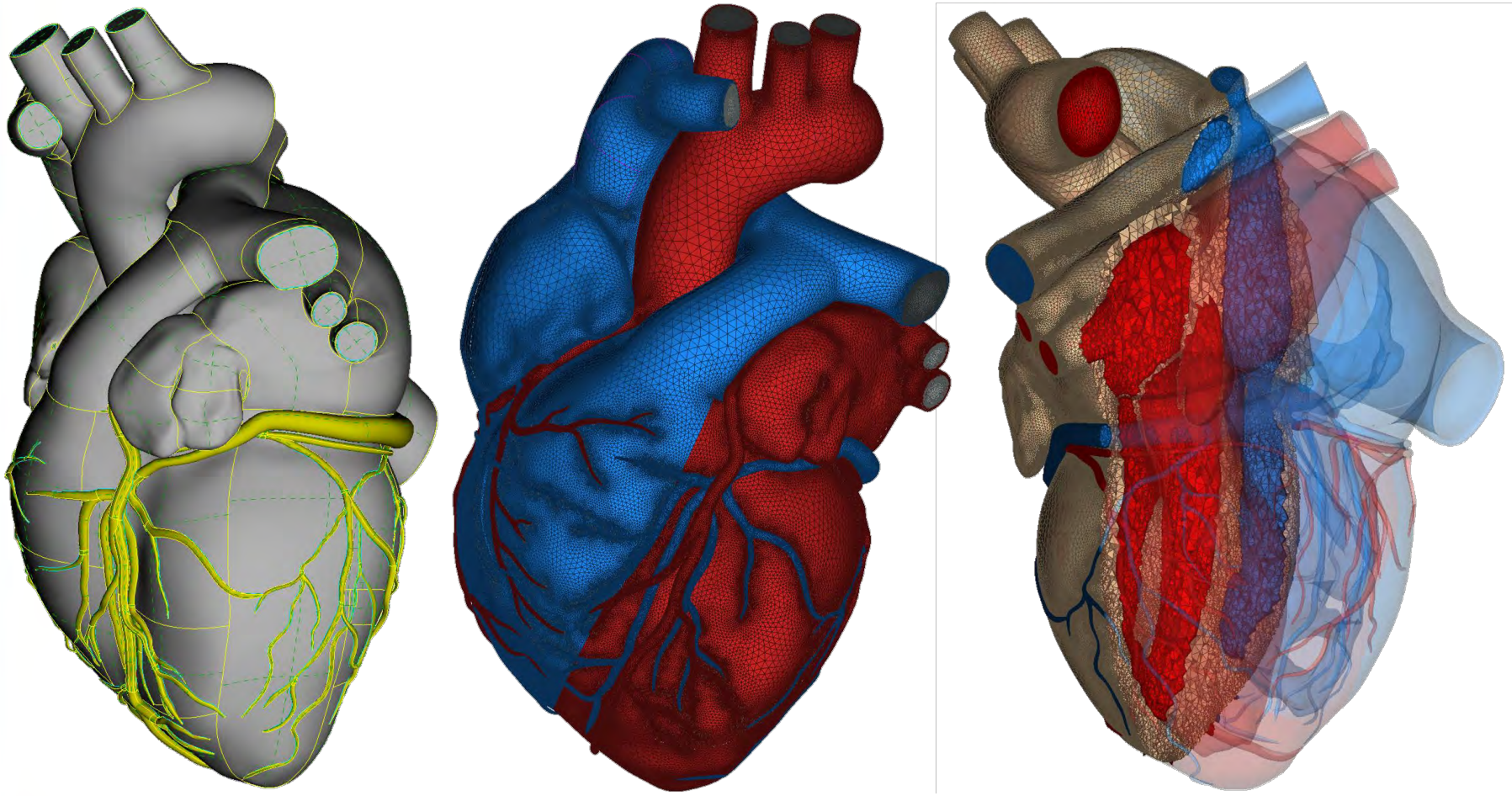




Courtesy of Evektor

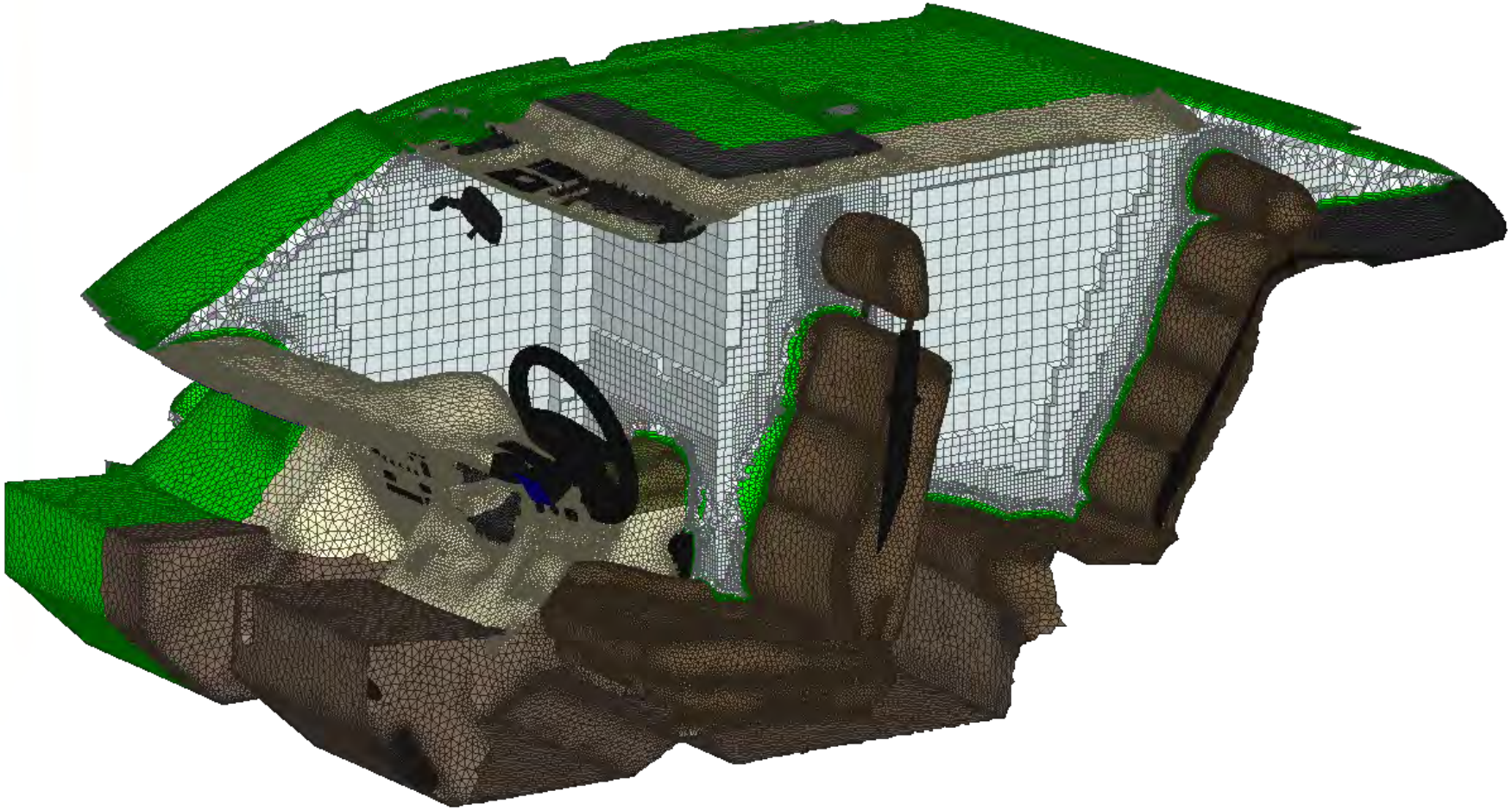
Complete volume mesh of a human heart

2 million trias, 23 million prisms and tetras



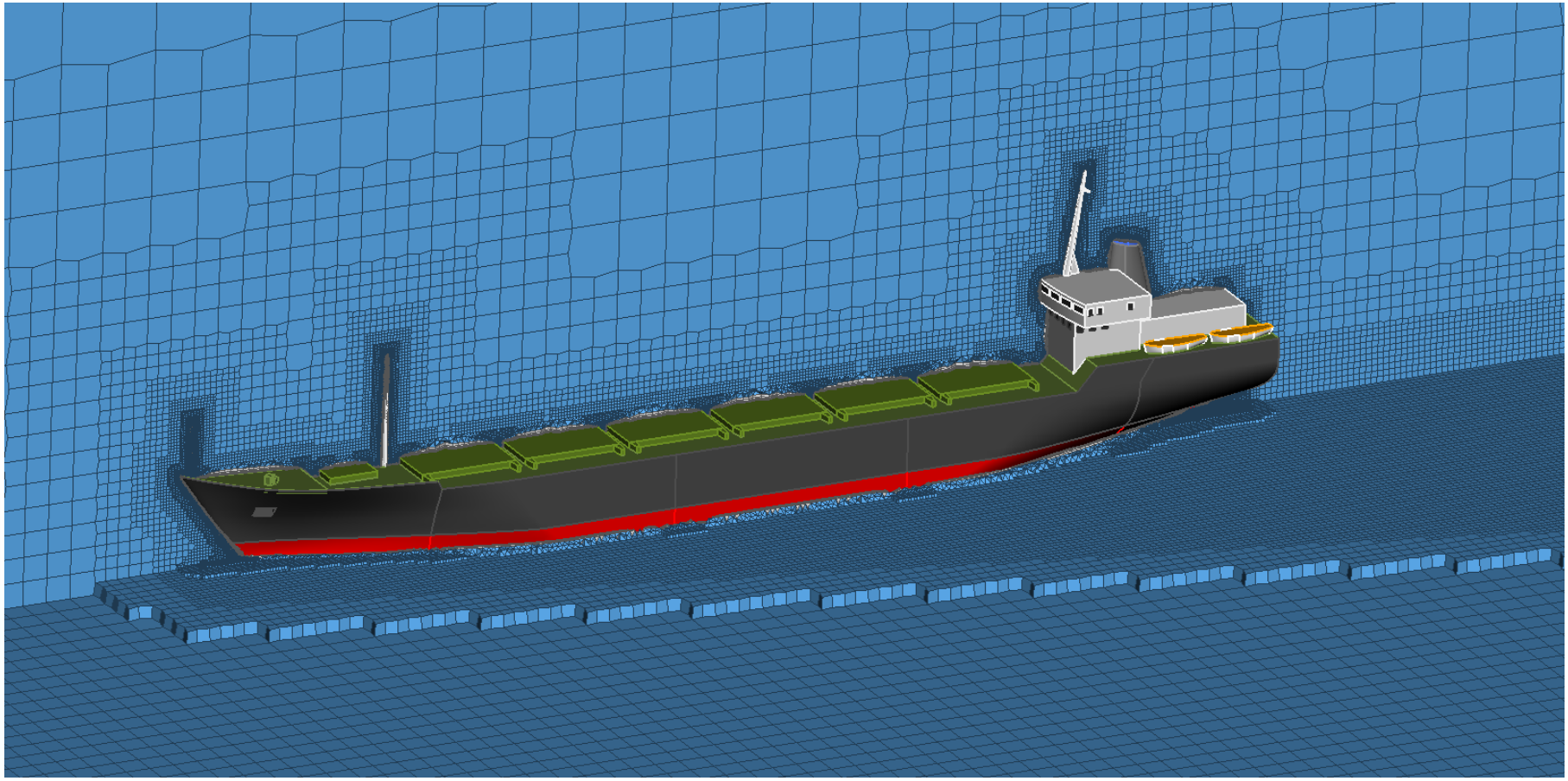
Hexa Interior algorithm

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



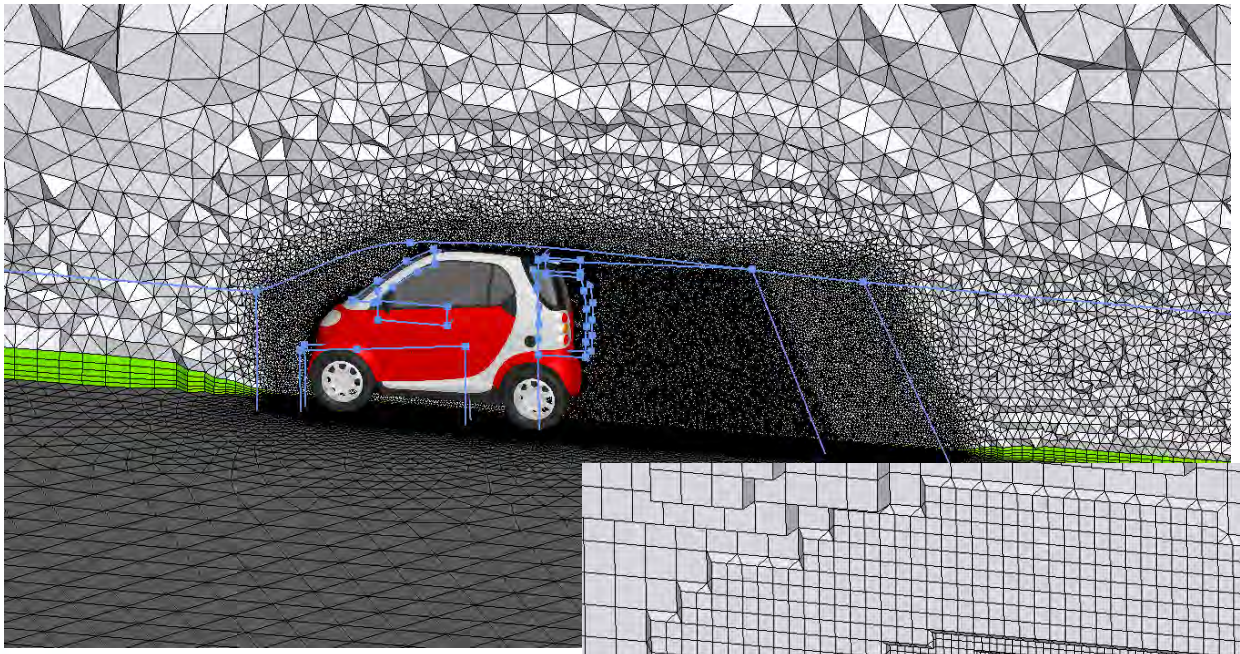
Polyhedral type volume meshing algorithm

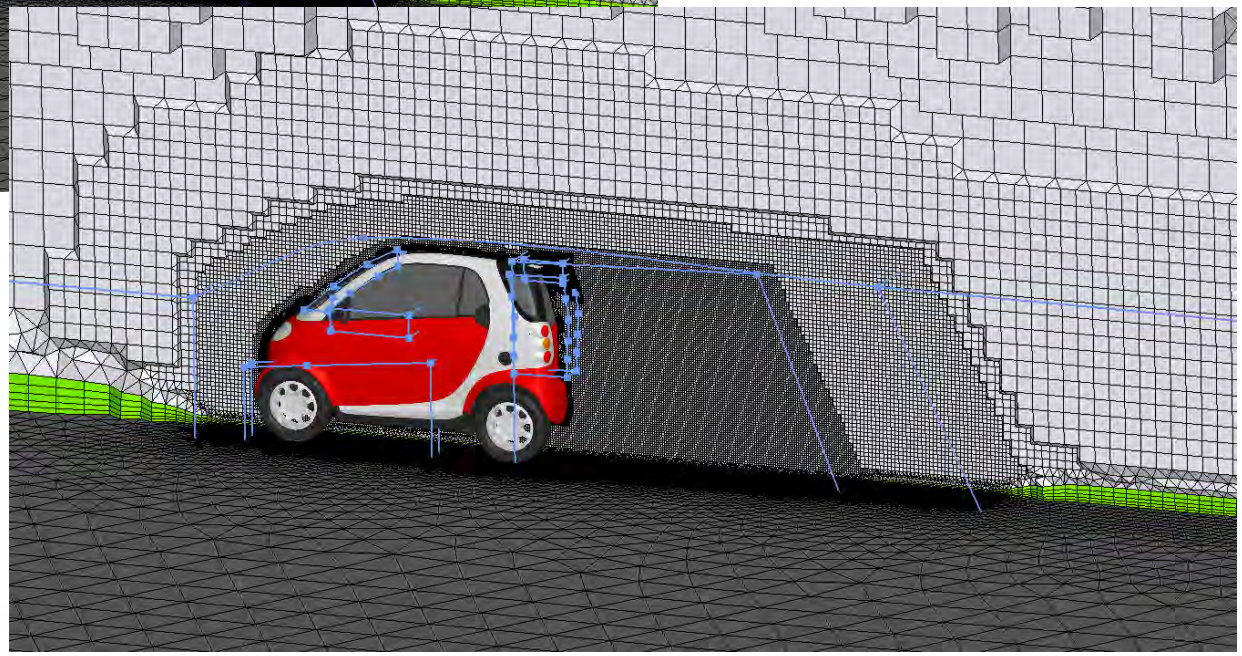
Variable size hexa mesh with polyhedral elements for transitions



Volume meshing: Size Boxes

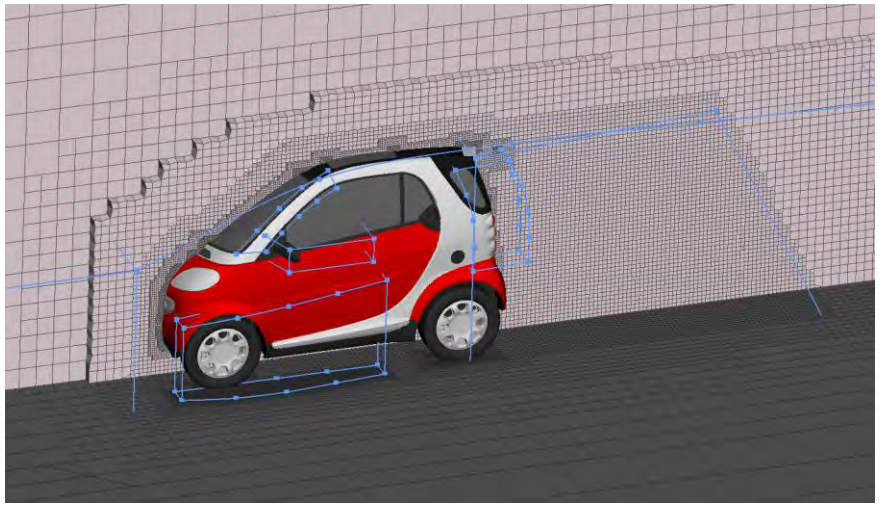
Size Boxes controlling max element size

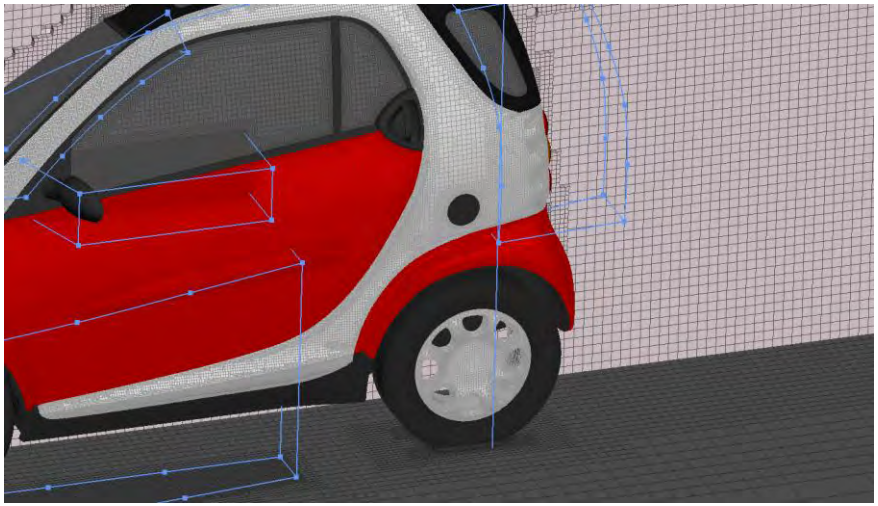


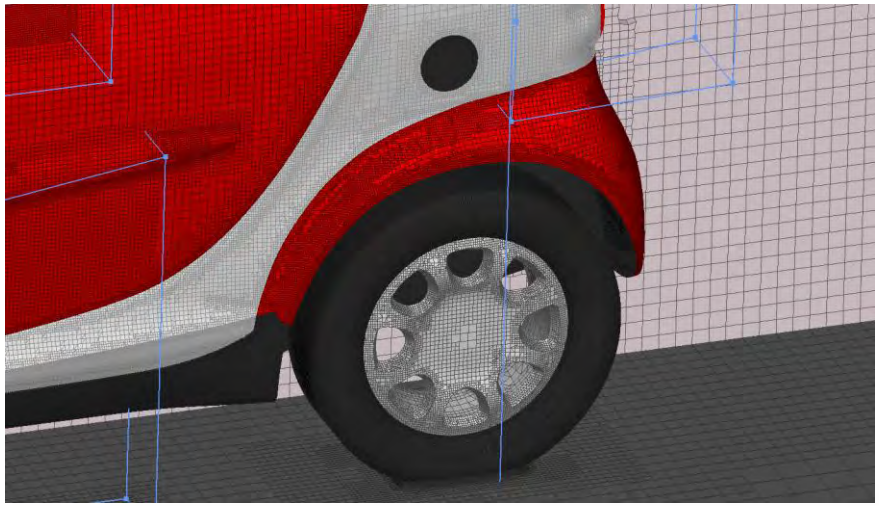


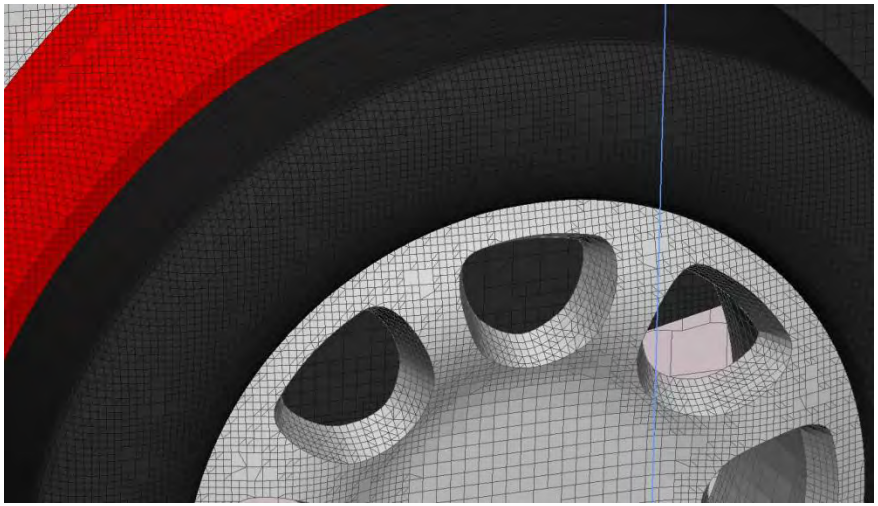
Trim hexa/polyhedral mesher

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









Volume meshing: Boundary layers generation

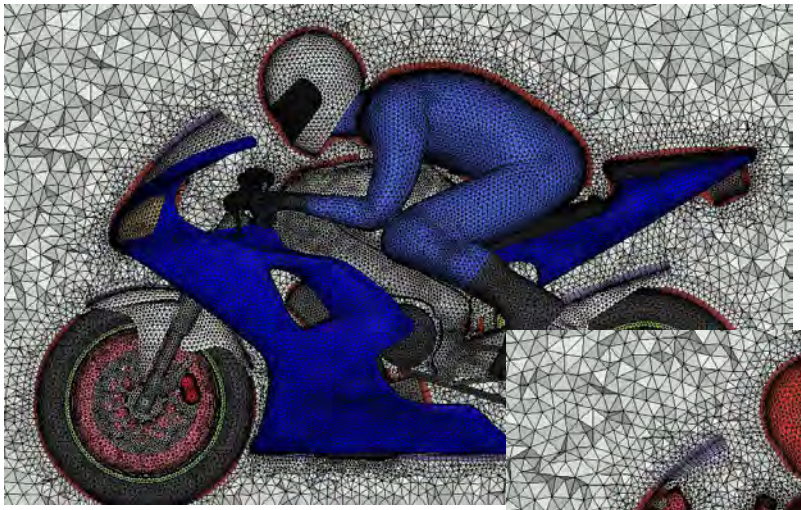
Multiple options:

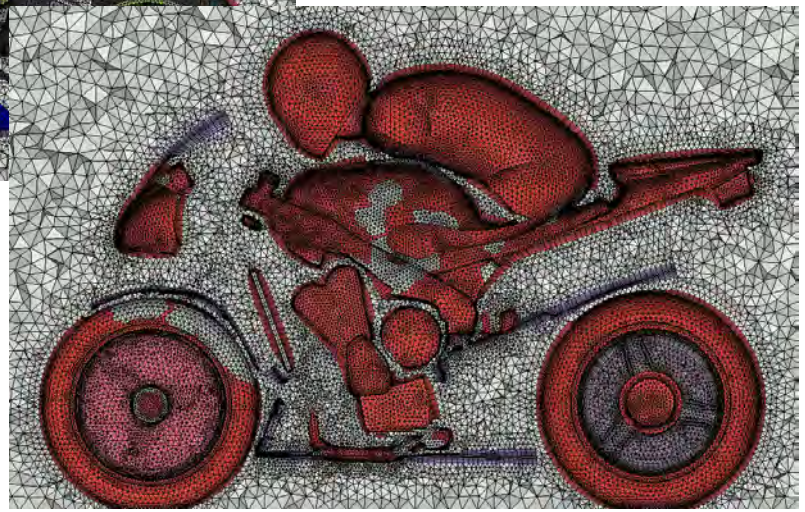
Auto exclude or collapse areas

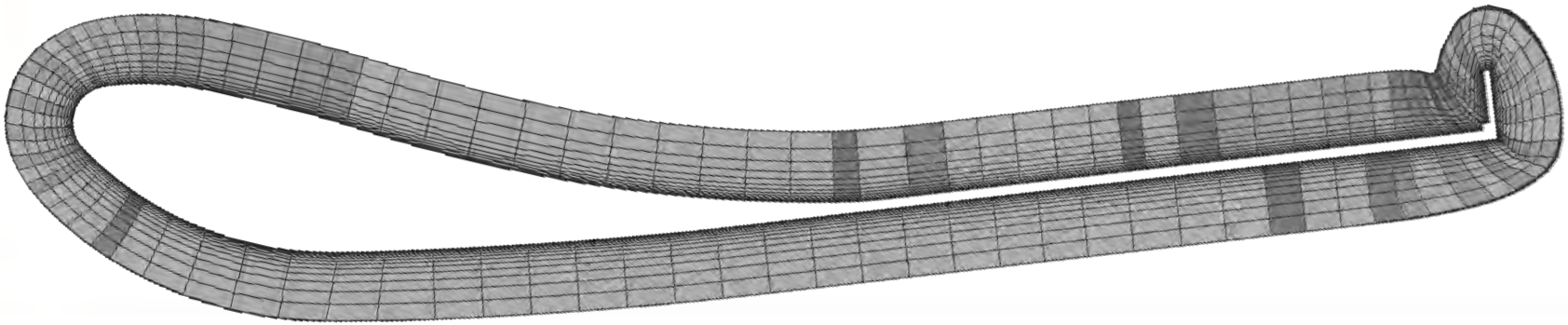
Controlled Layer Squeezing to avoid intersections

Layers from selected areas with different settings

Layers from zero-thickness walls

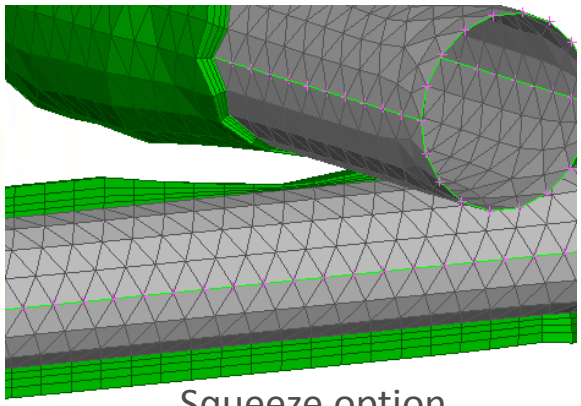




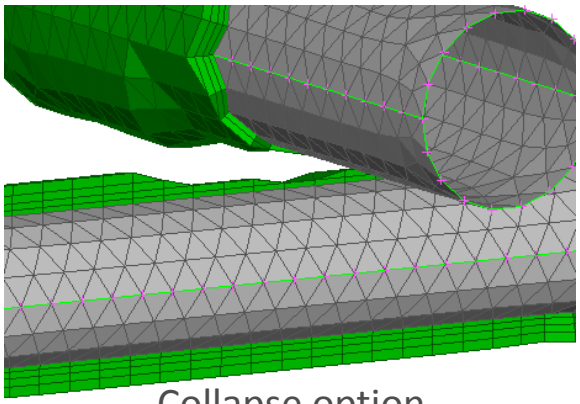


Boundary layers exclude mode

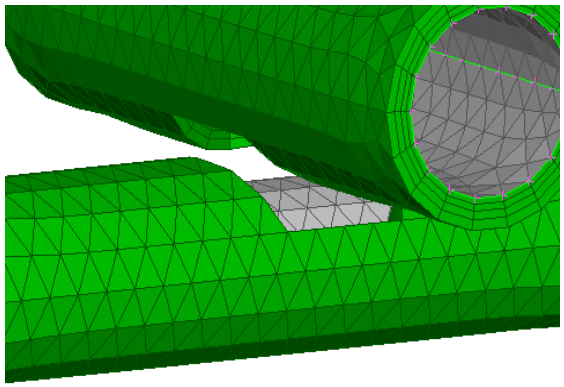
Automatic fix of intersection and proximities in any of three options



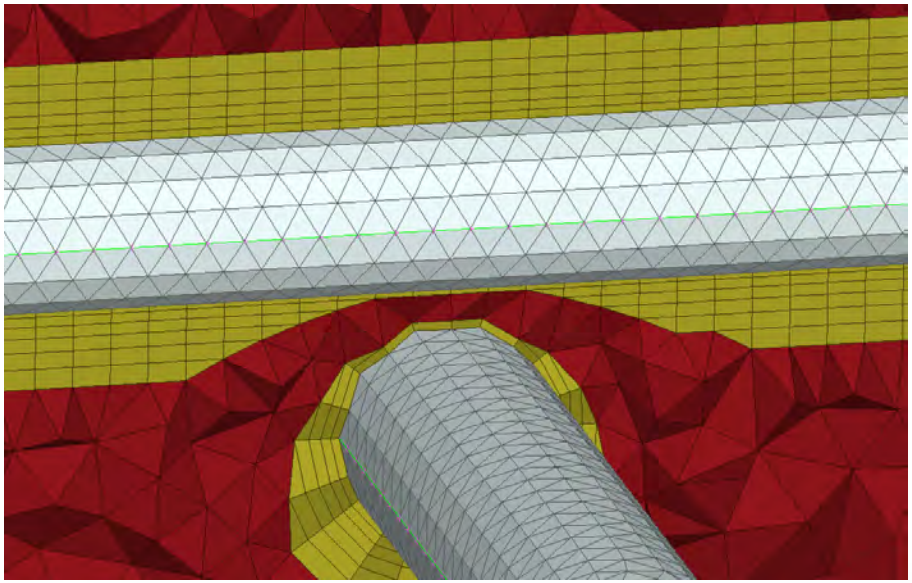
Squeeze option

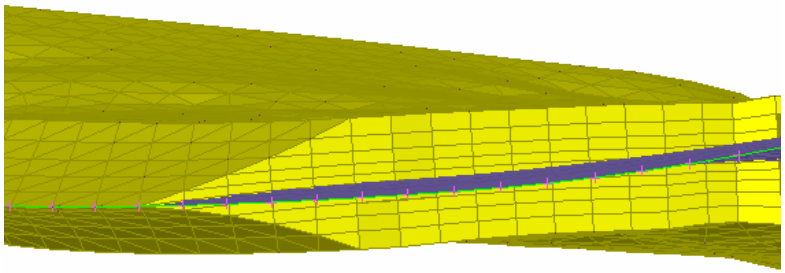


Collapse option



Exclude option

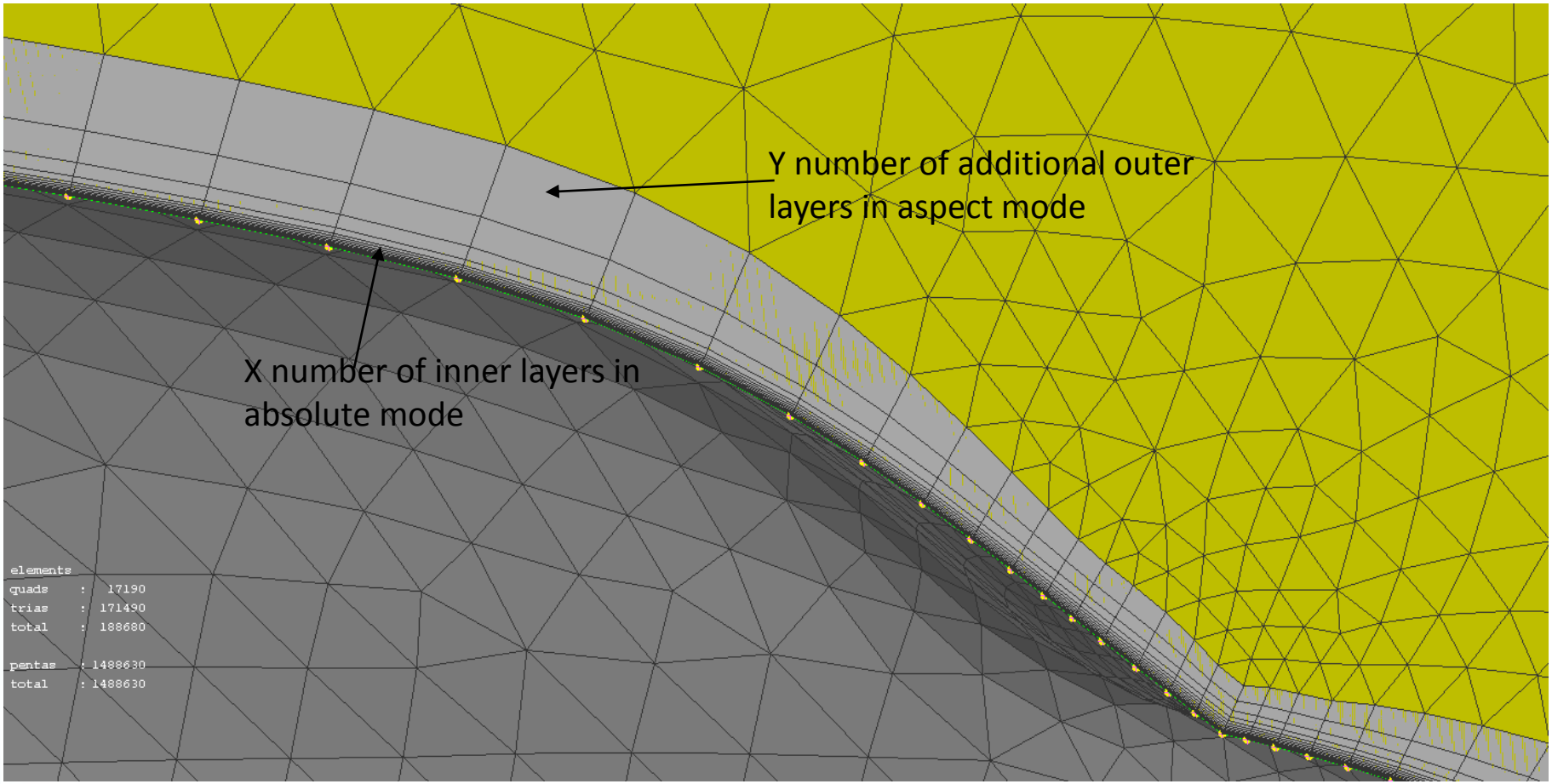




Collapse free edges

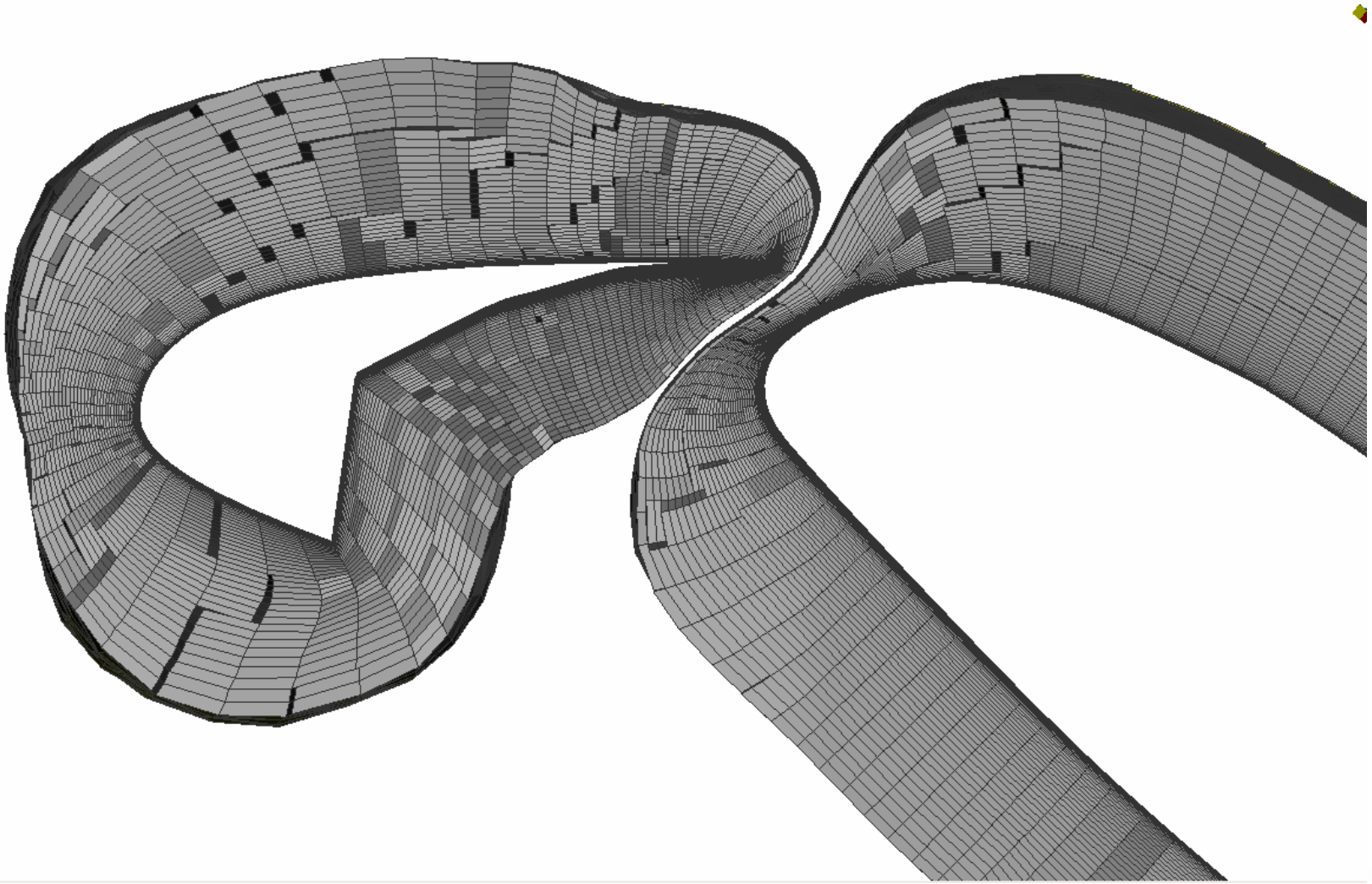
Flexible specification of layer growth

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

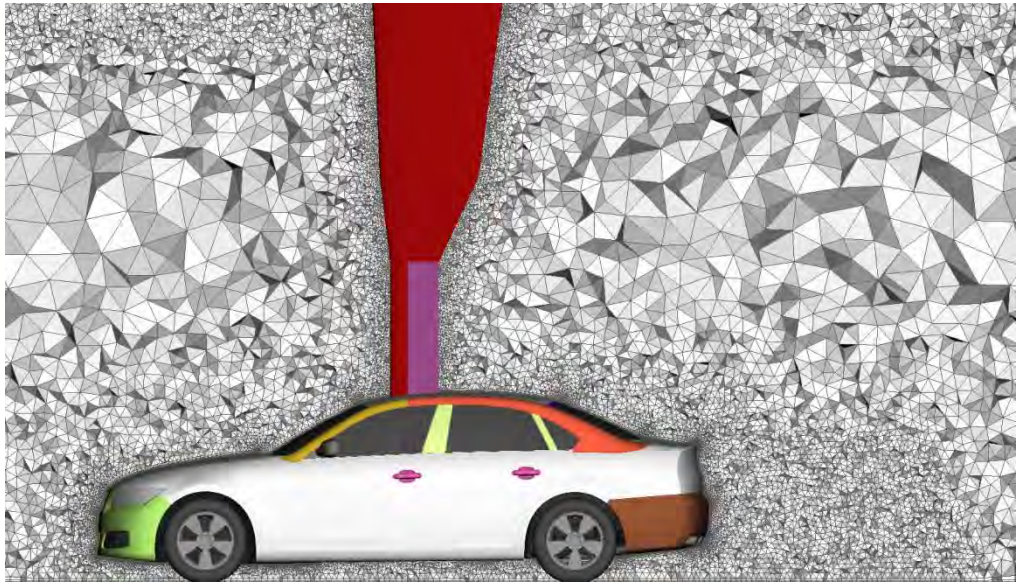


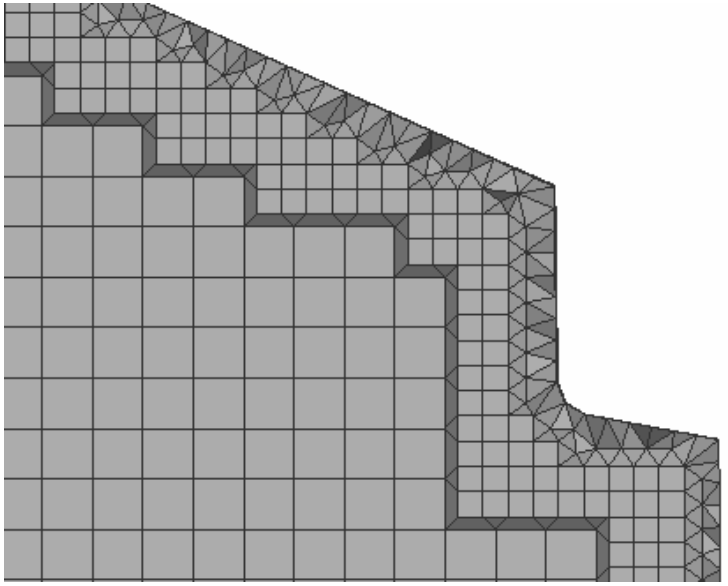
Robust layers generation at extreme heights

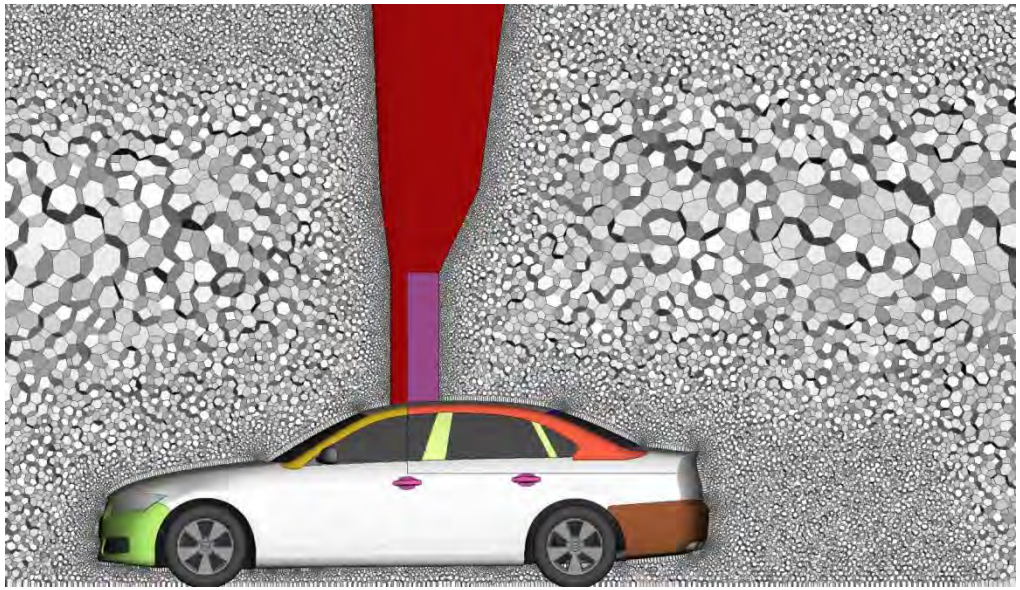
Powerful algorithm for very large total layer height and severe proximities

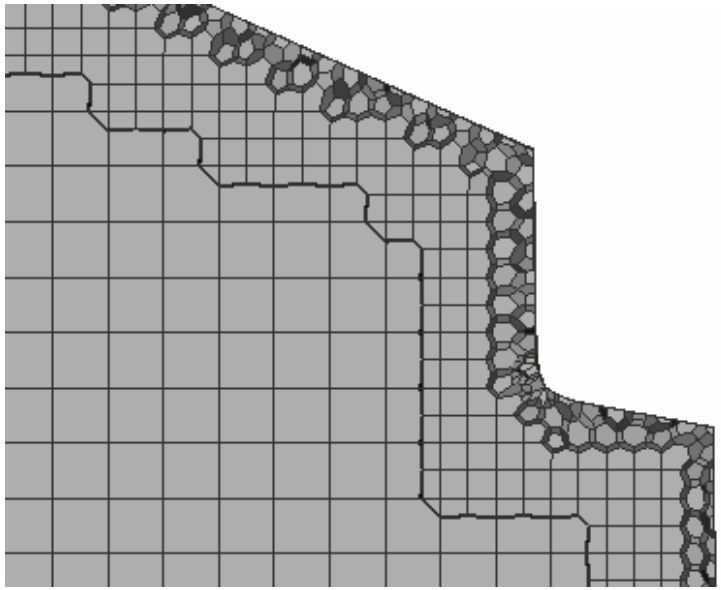


Conversion of hybrid to polyhedral meshes

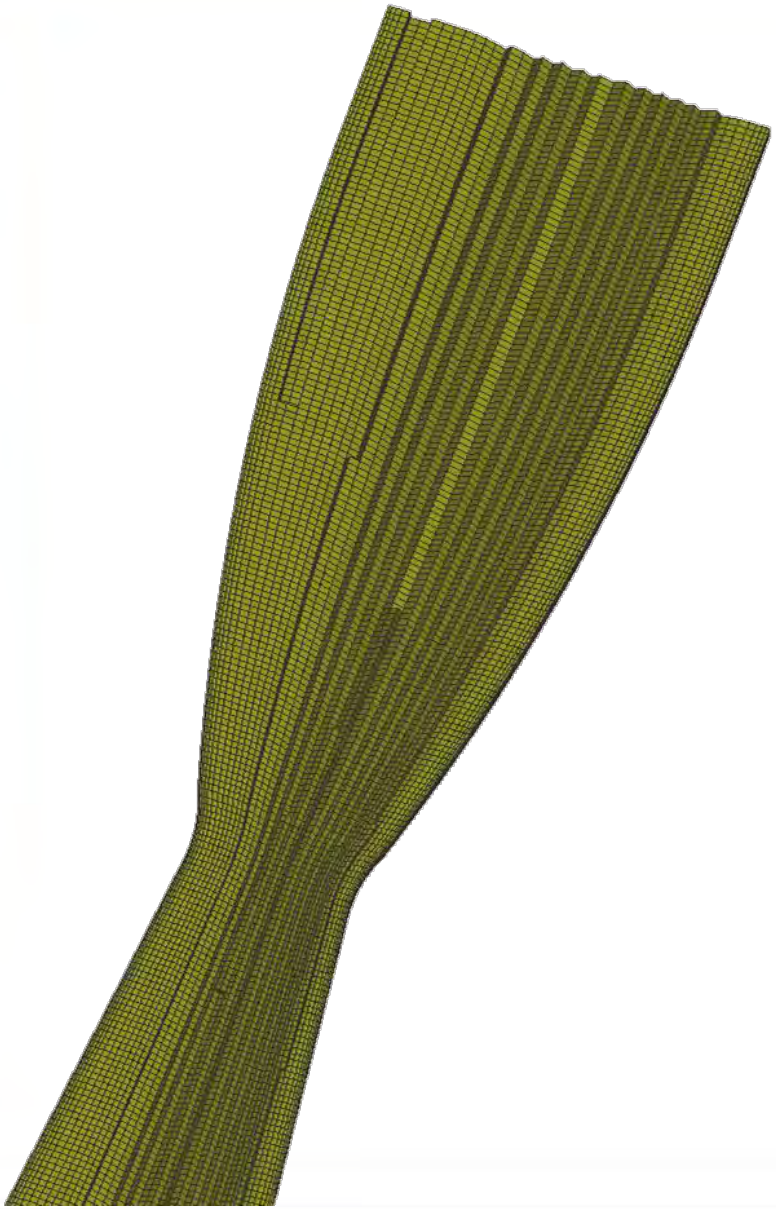




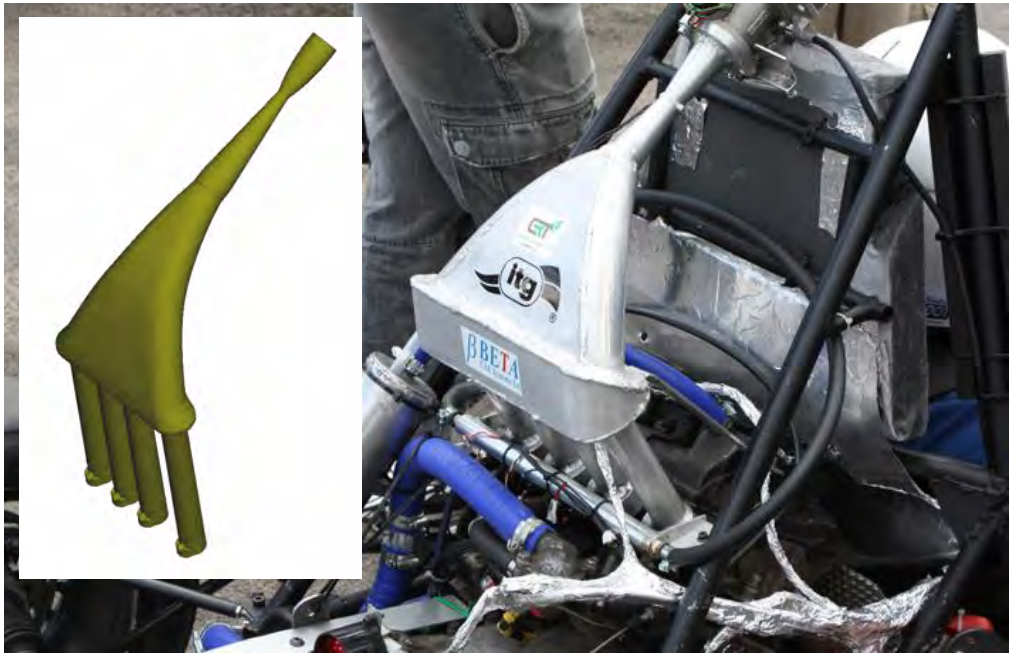




Volume meshing: Hexa/Penta map meshing



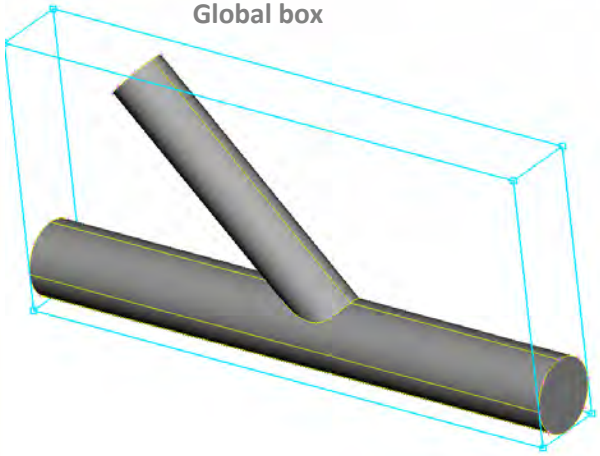
By permission of
City University racing team



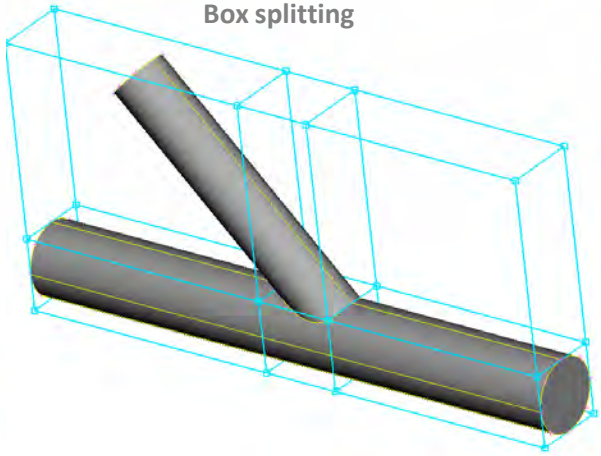
HexaBlock meshing

Hexa meshing based on block structures associated to the model

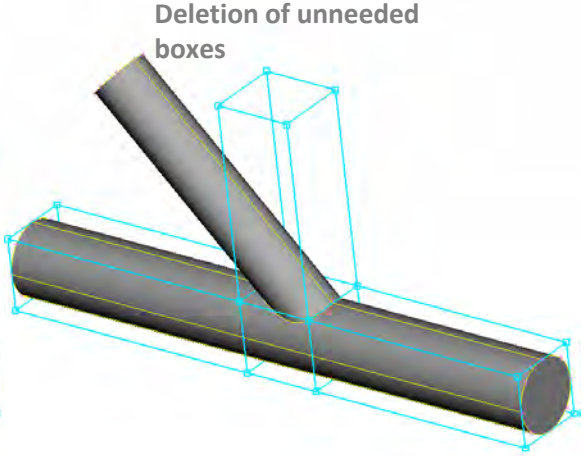
Global box



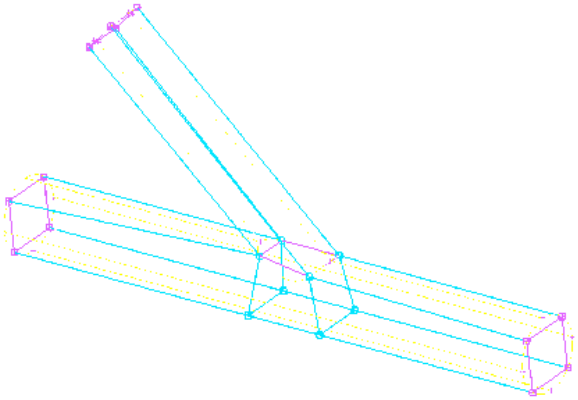
Box splitting



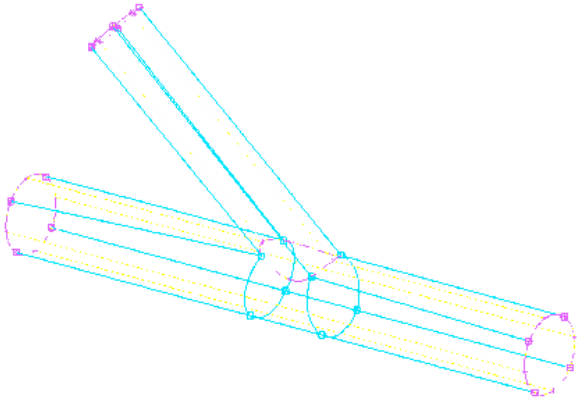
Deletion of unneeded boxes



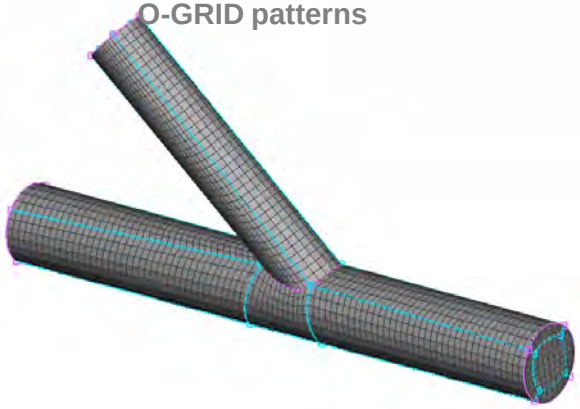
Snapping of points



Snapping of edges

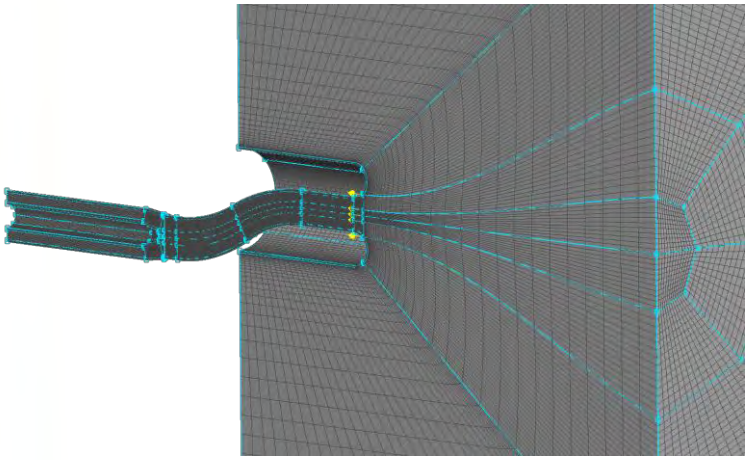
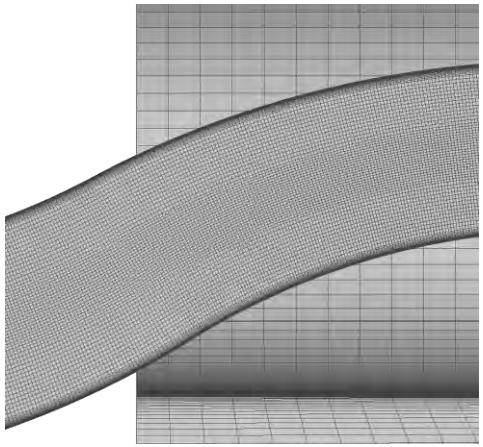
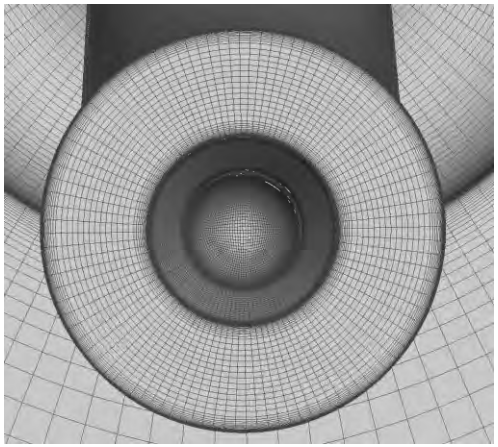
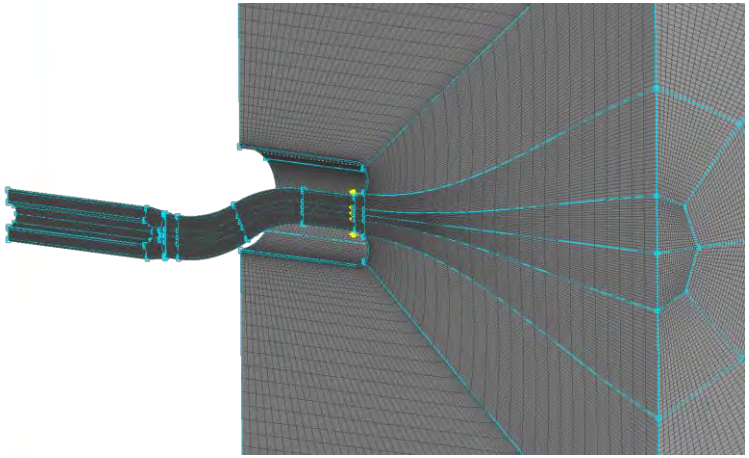
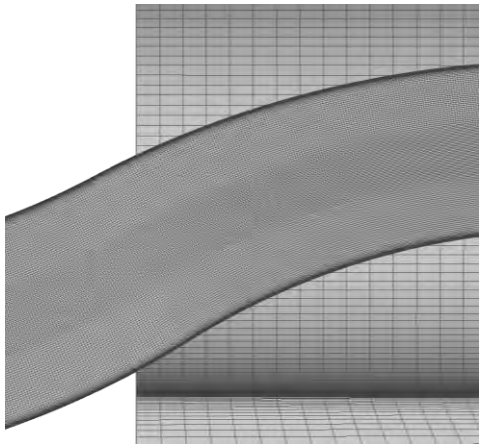
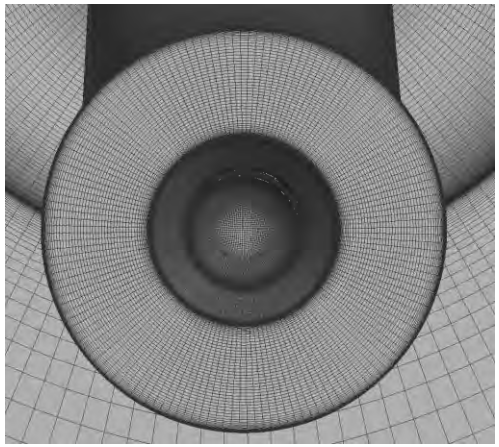


Hexa mesh with O-GRID patterns



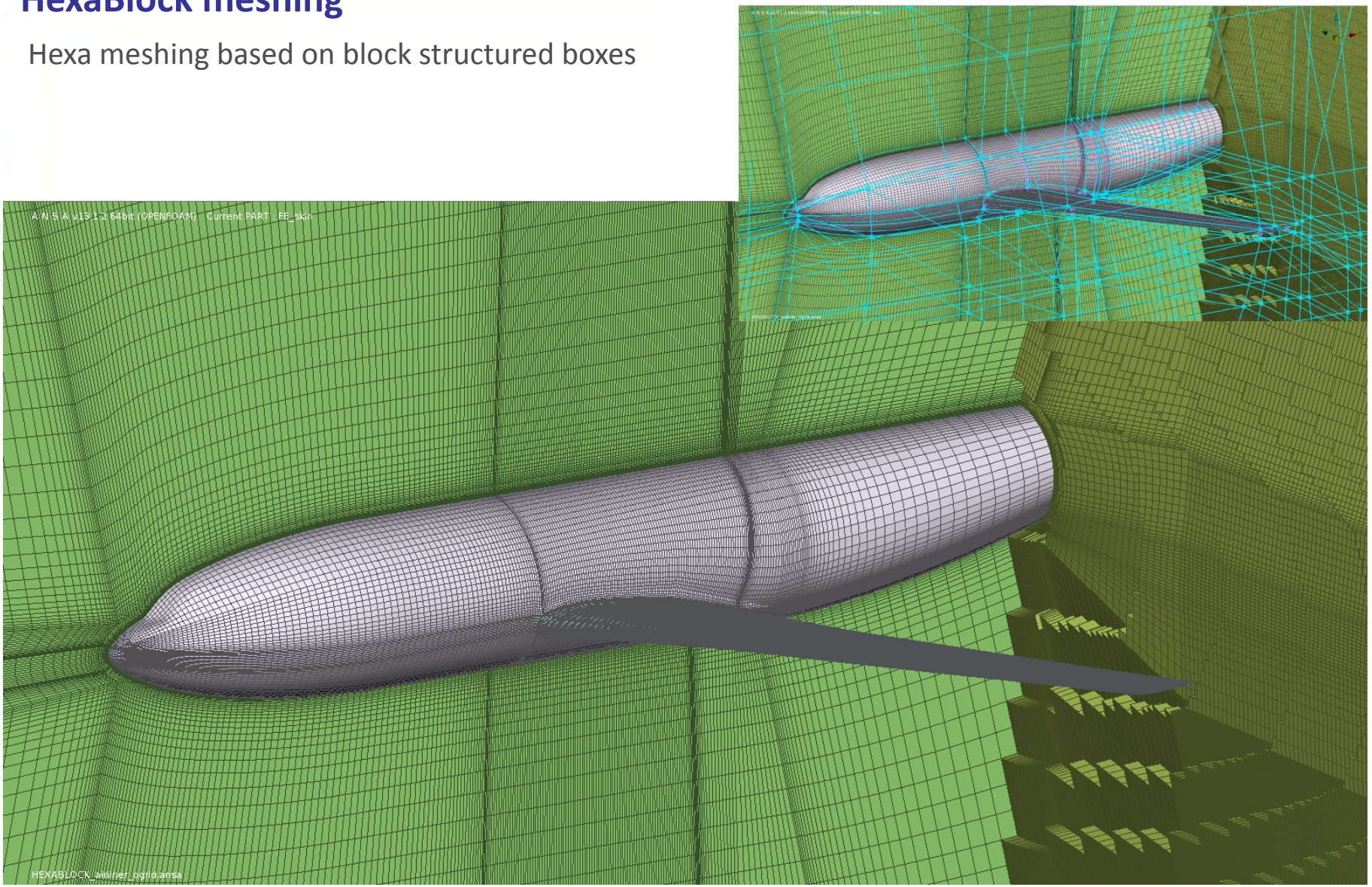
HexaBlock meshing

Numerical simulation of flow through S-duct - 1st Propulsion Aerodynamics Workshop July 2012

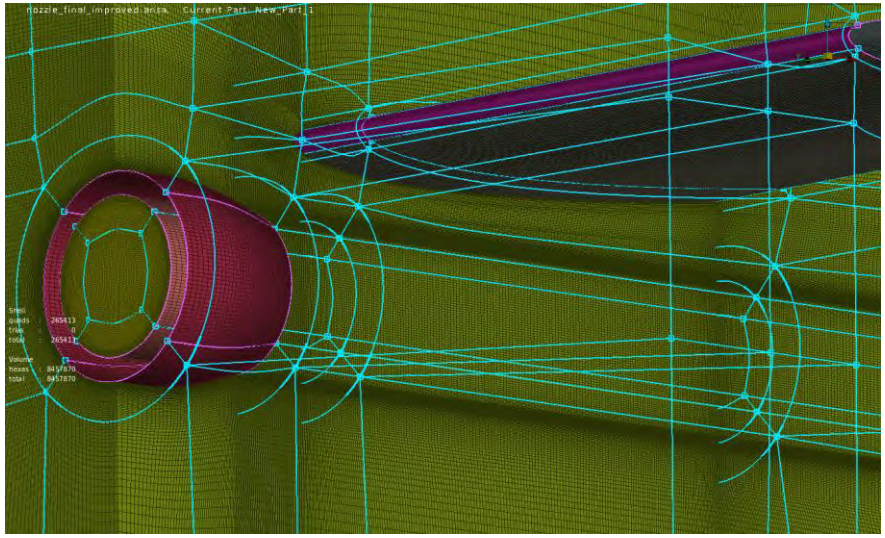
HexaBlock meshing

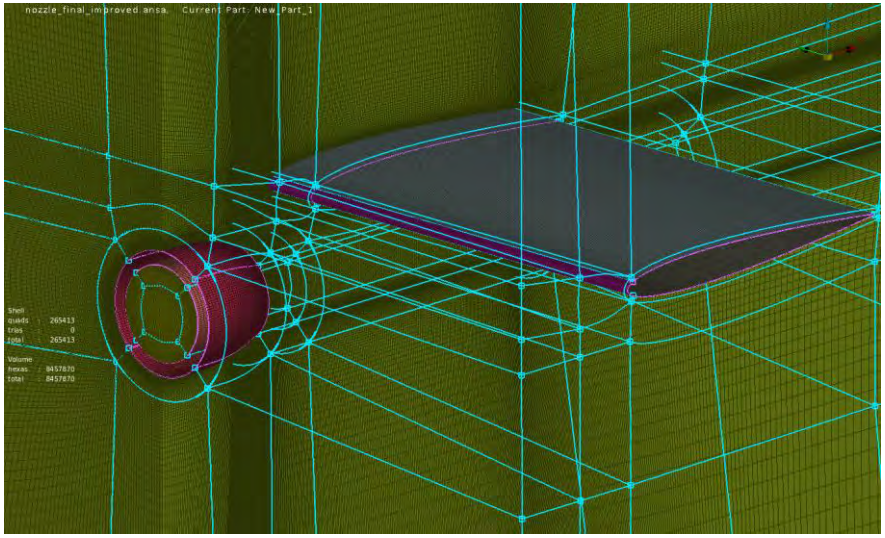
Hexa meshing based on block structured boxes



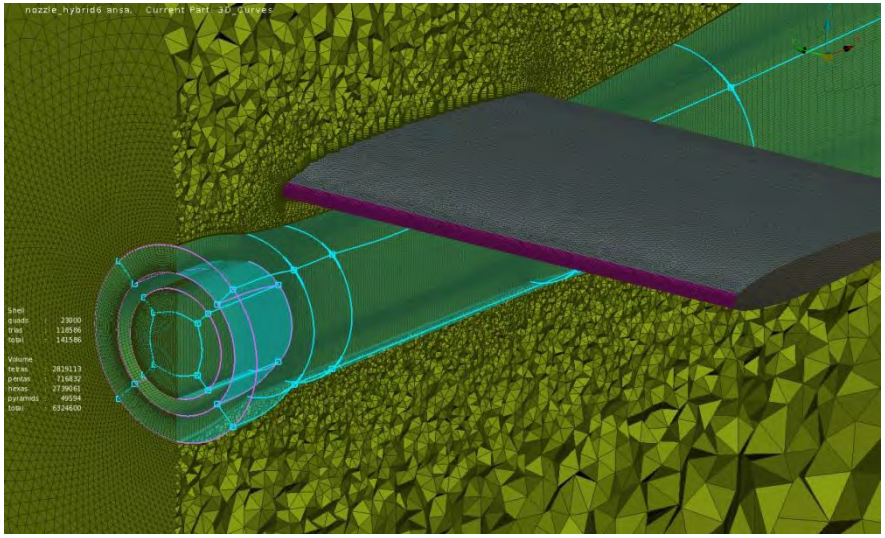
HexaBlock meshing: generic jet exhaust under wing

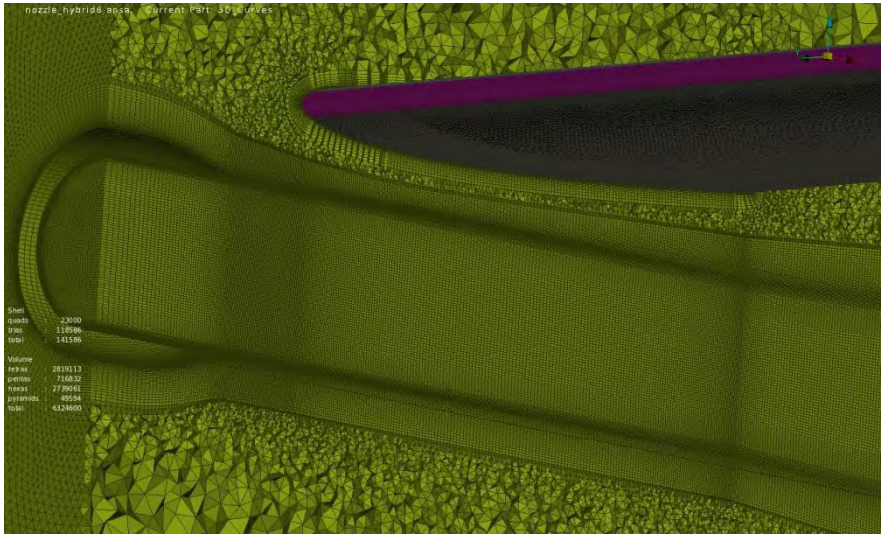
Pure Hexa Mesh



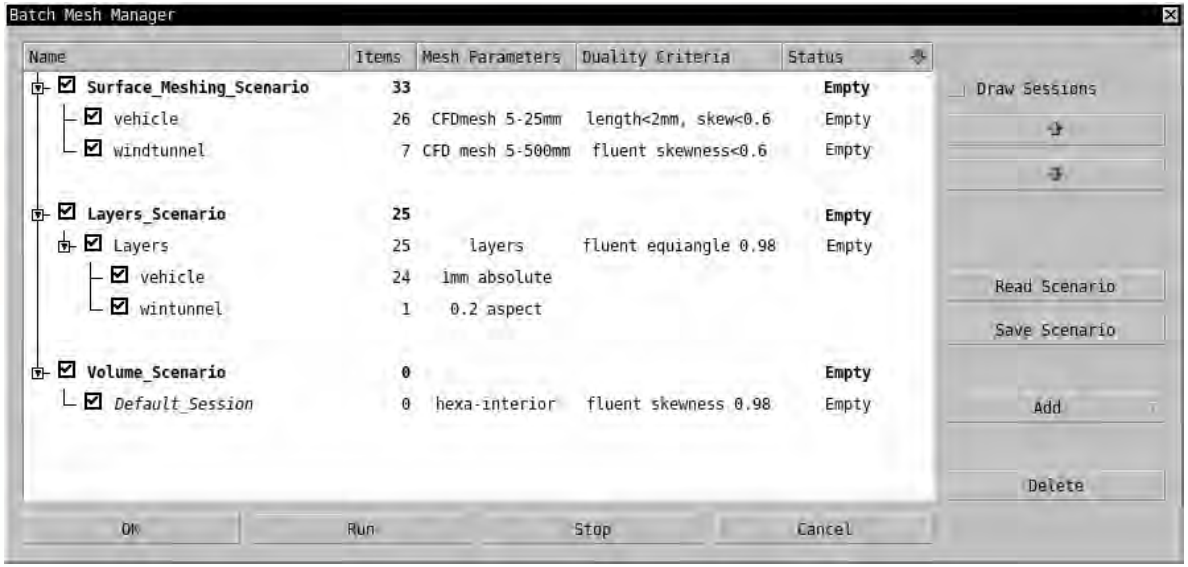


Combination of hexa mesh with hybrid mesh

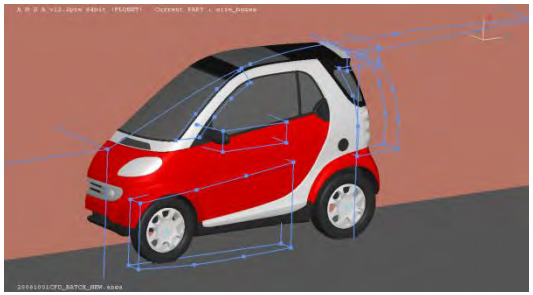


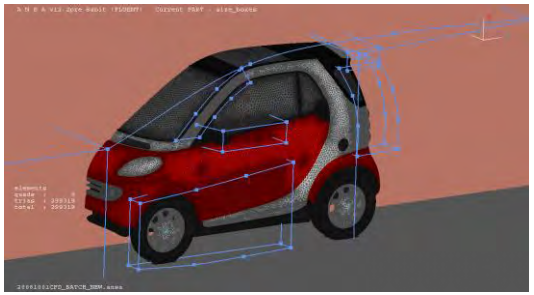


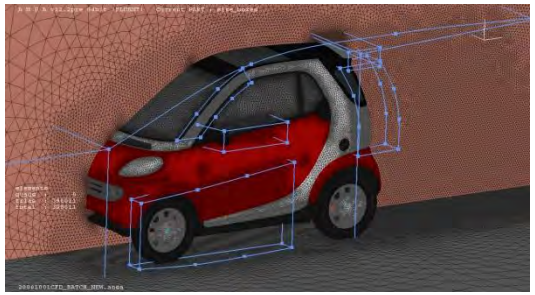
Batch Mesh tool for complete CFD meshing automation

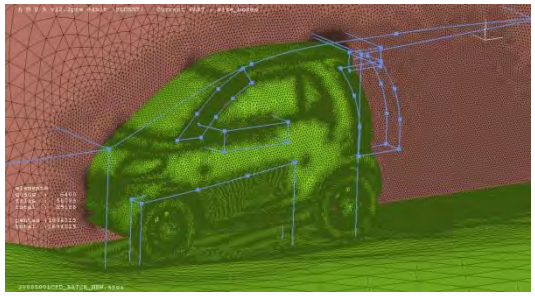


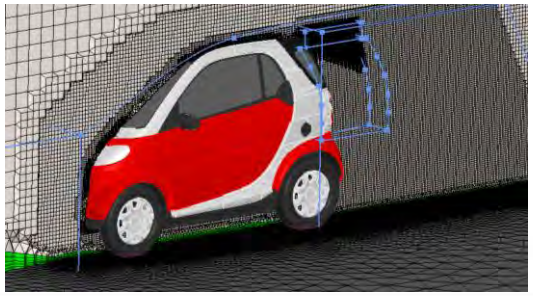
Batch Mesh provides:
- Automation
- Consistency
- Mesh specs traceability





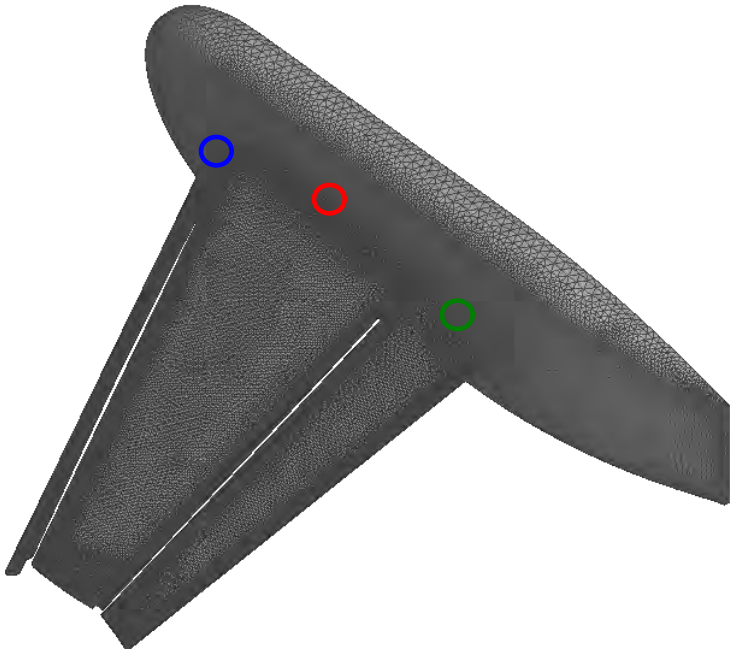


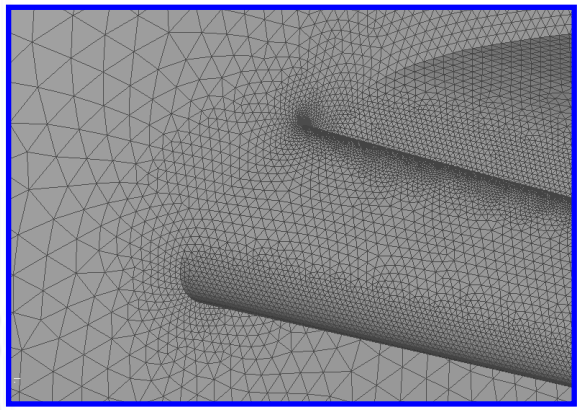


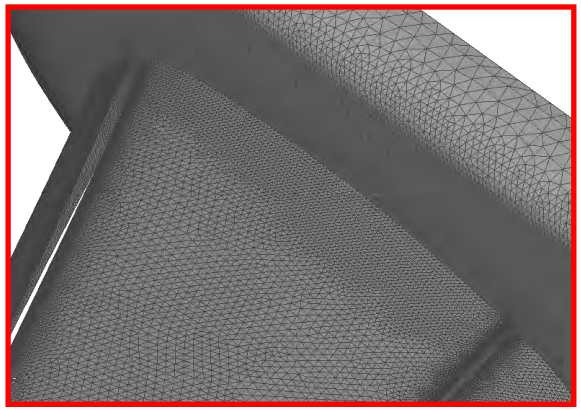


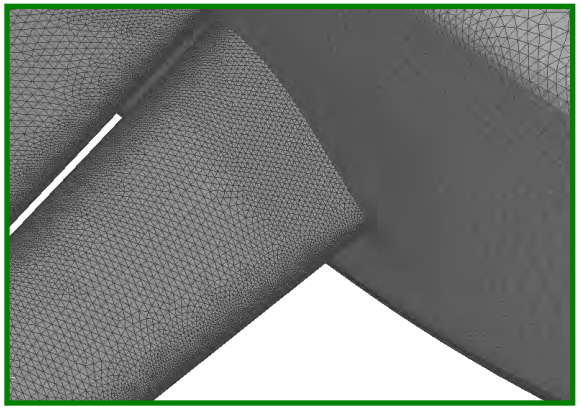
Automated mesh refinement study - 1st High Lift Prediction Workshop

Coarse



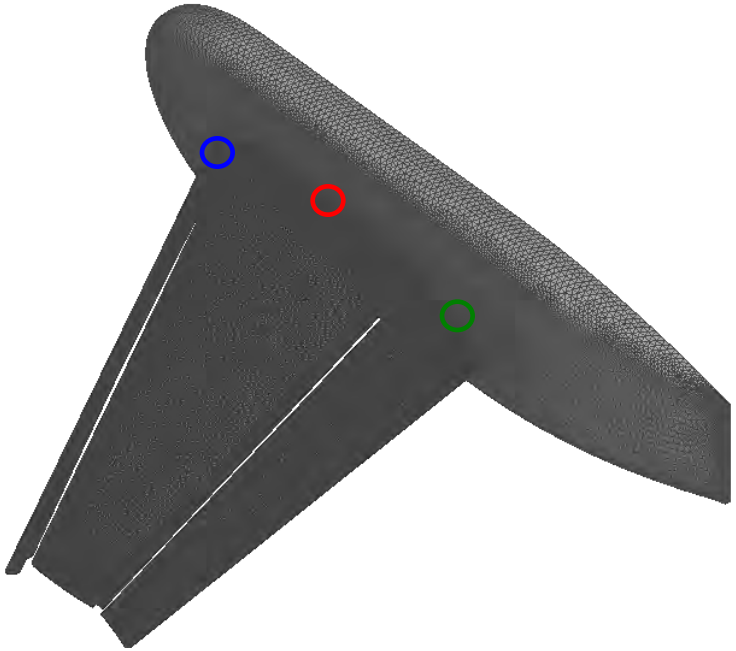


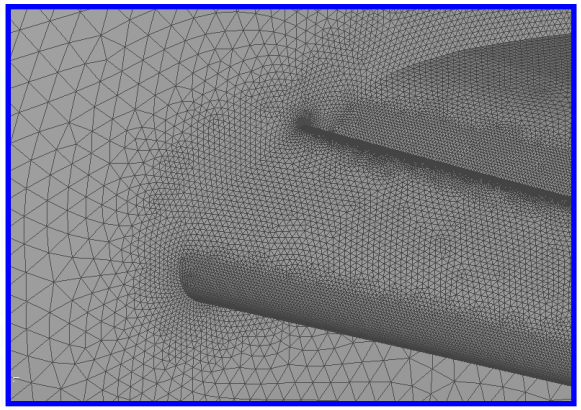


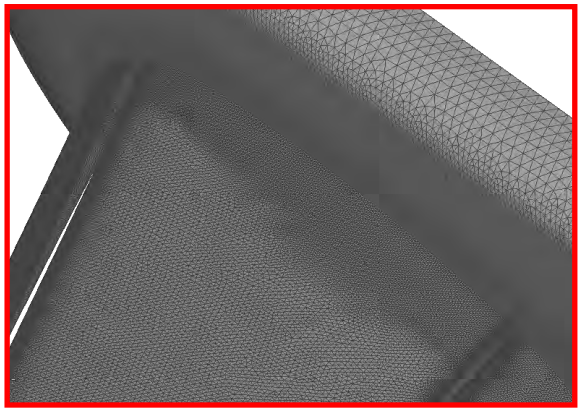


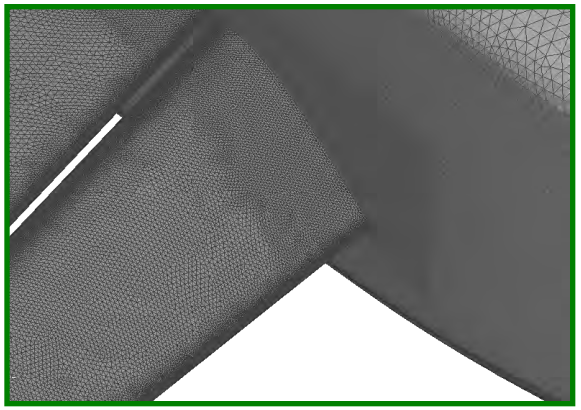
Automated mesh refinement study - 1st High Lift Prediction Workshop

Medium



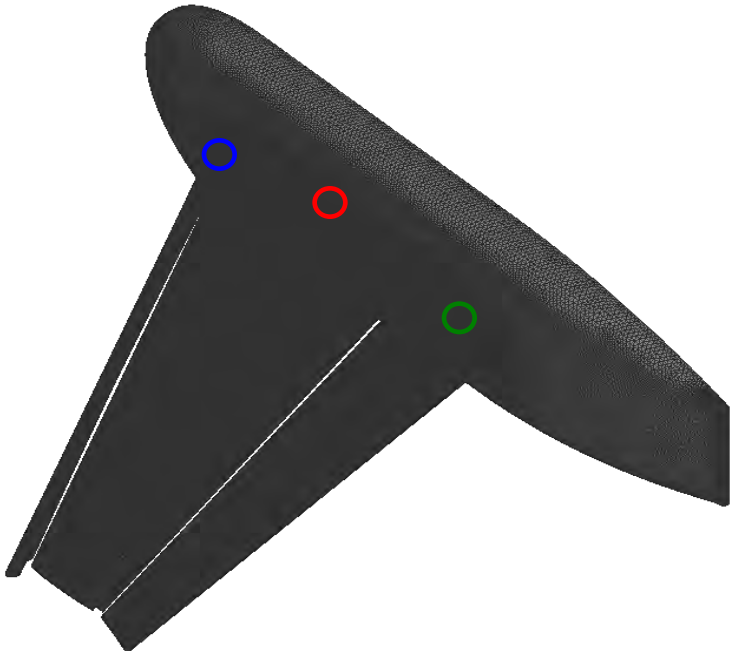


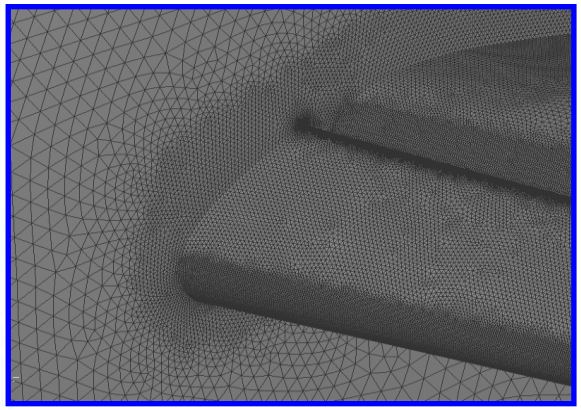


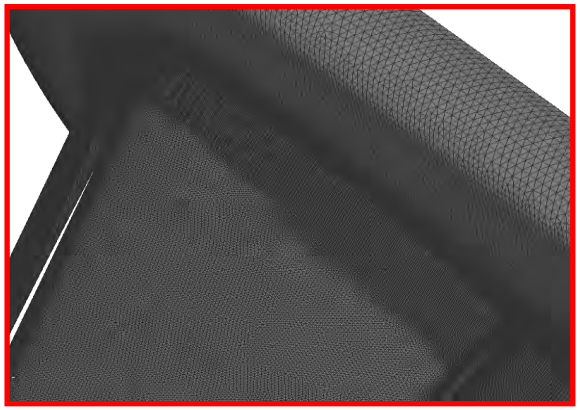


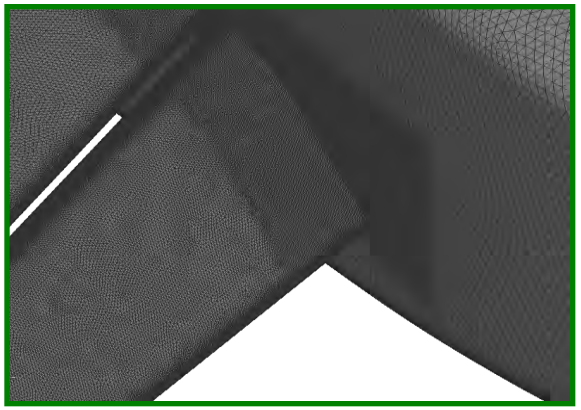
Automated mesh refinement study - 1st High Lift Prediction Workshop

Fine



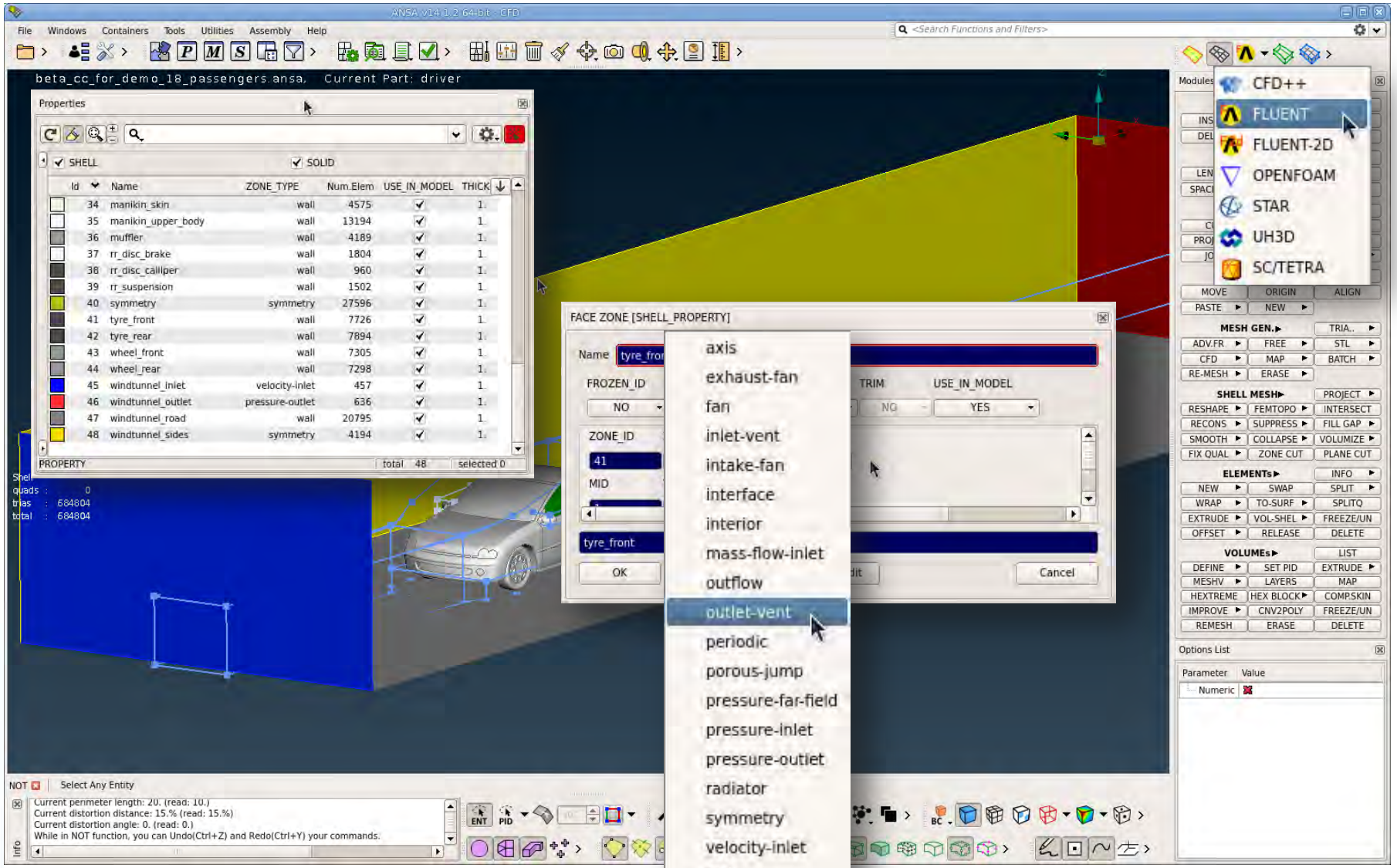






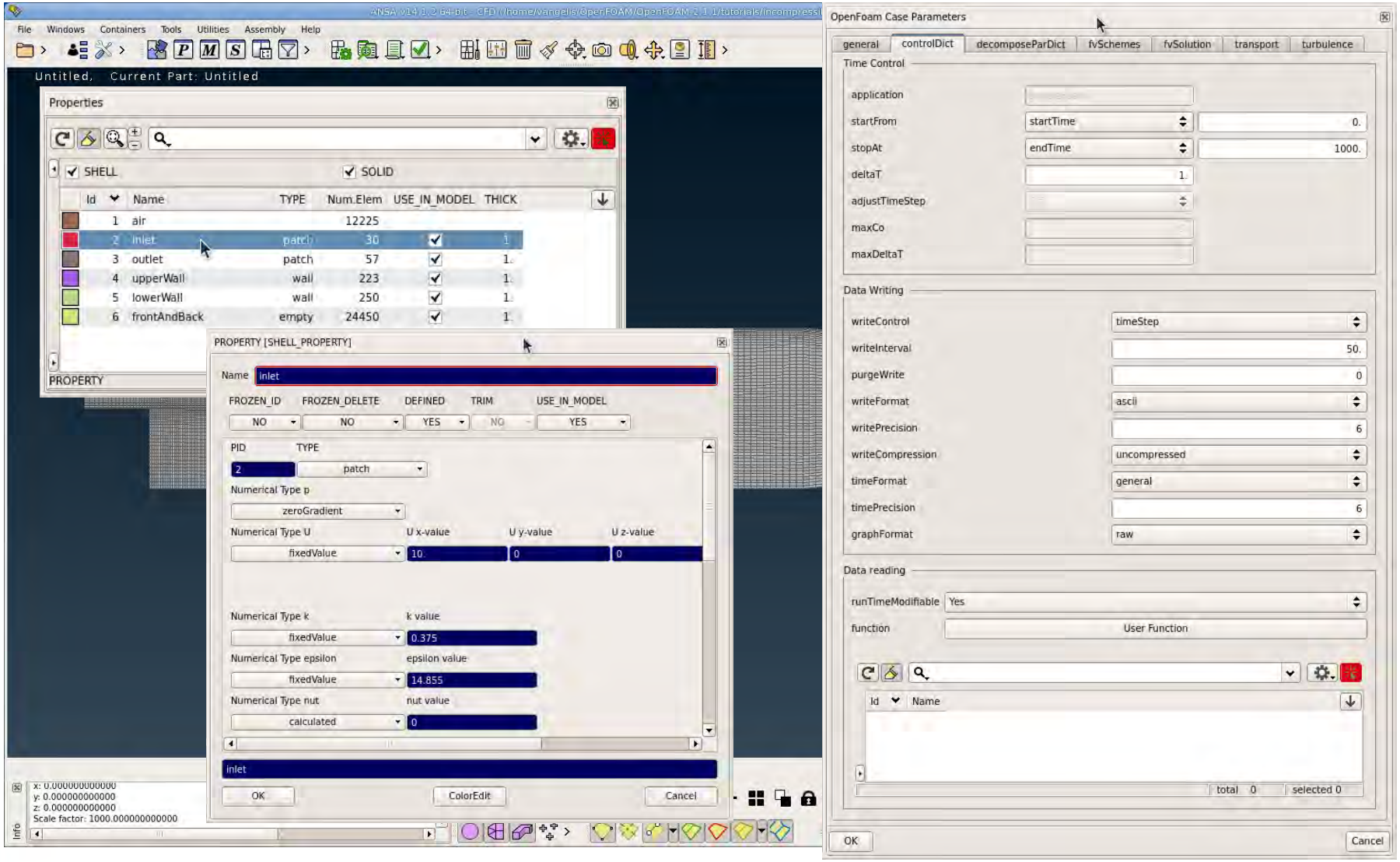
Solver Setup

Boundary Condition type specification for various CFD solvers



Output also in CGNS and CFX5 formats

Full support of OpenFOAM mesh and case setup



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

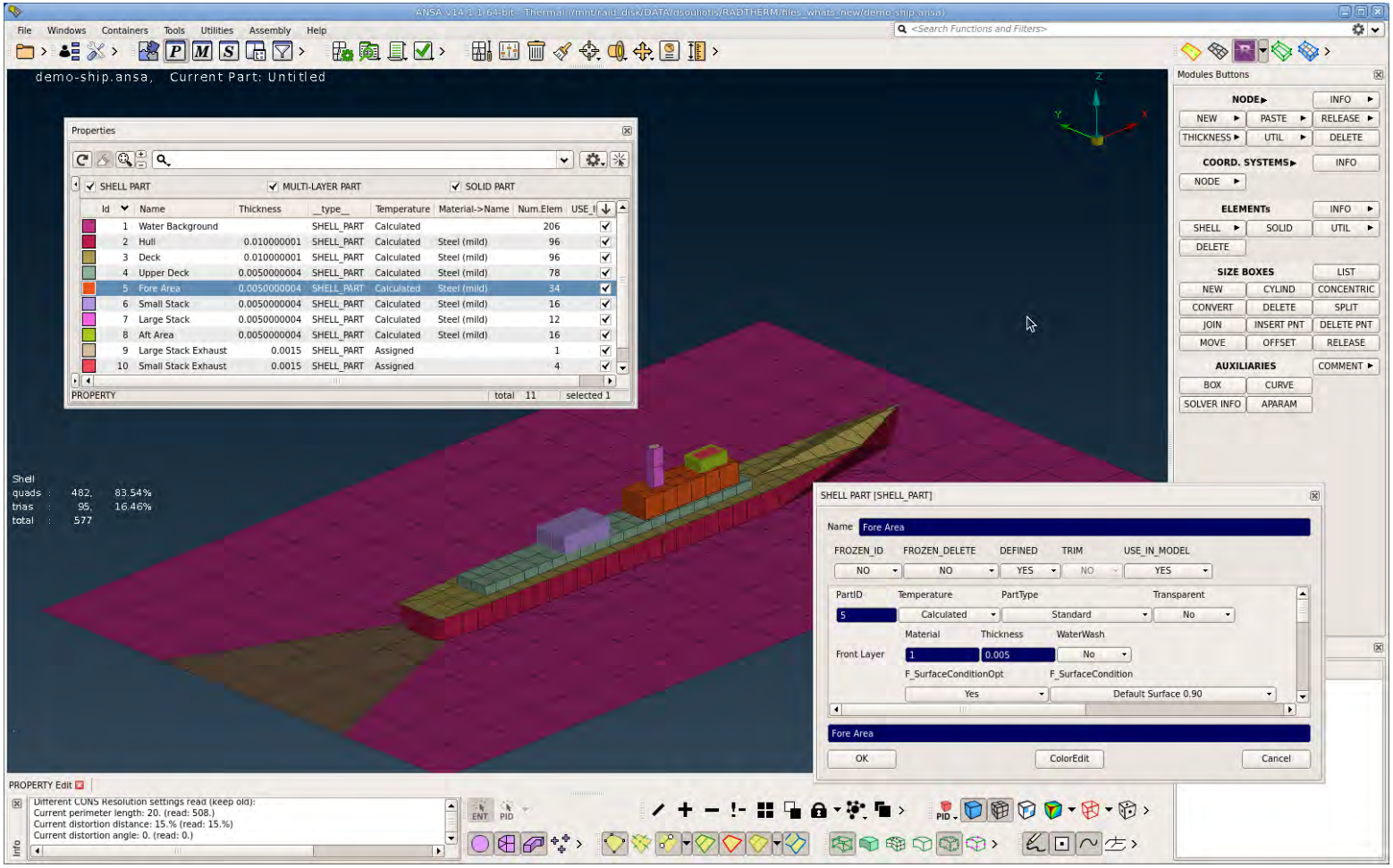
Thermal Management simulations support for RadTherm and THESEUS-FE

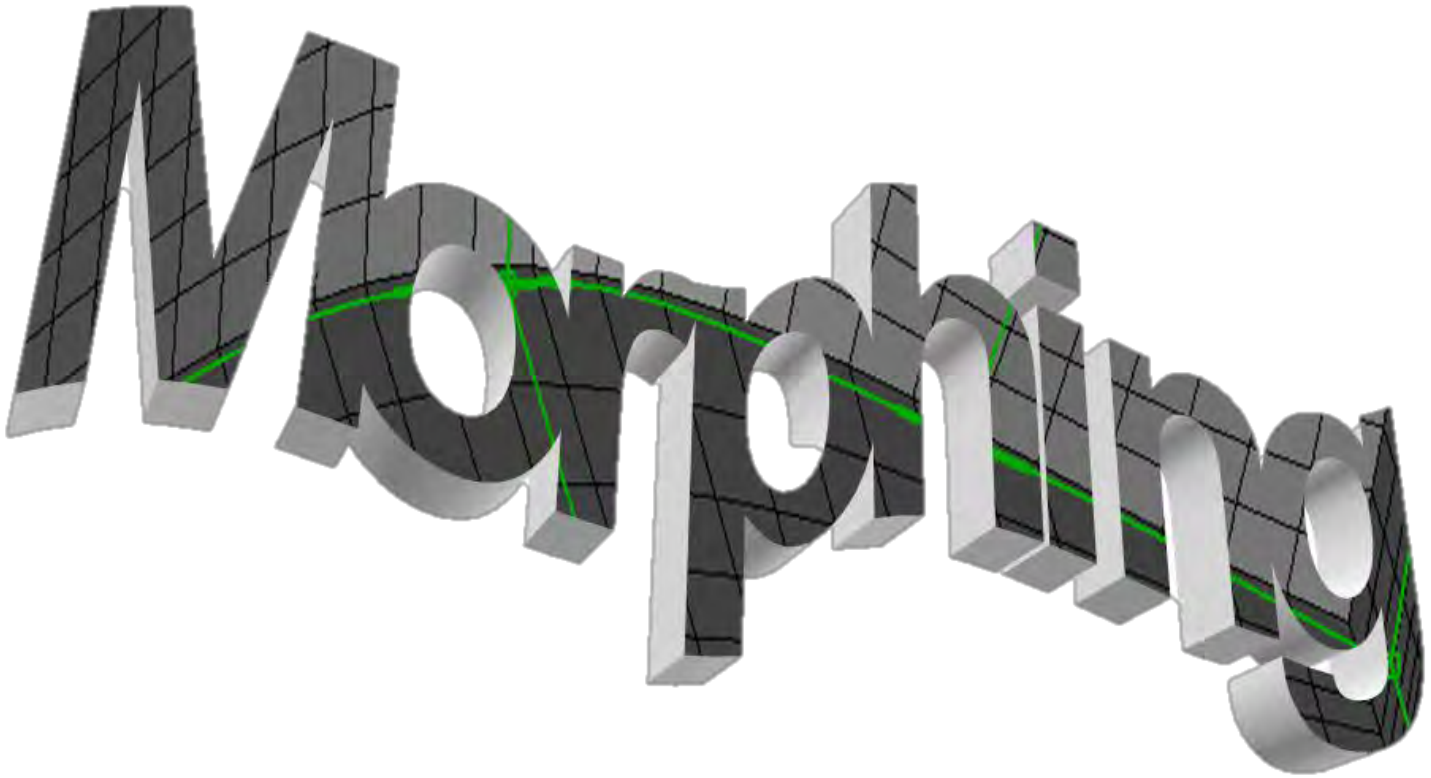
Direct I/O of native *.tdf files (Radtherm) and *.tfe files (THESEUS-FE)

Support of shell and solid mesh, Parts (single and multilayer)

and Assemblies, Materials, Boundary conditions

and main solver settings





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 allows scaling and history tracking of morphing actions

- It is applicable to surface & volume mesh and geometry

- It employs fast morphing algorithms that can be used efficiently and robustly on large CFD models

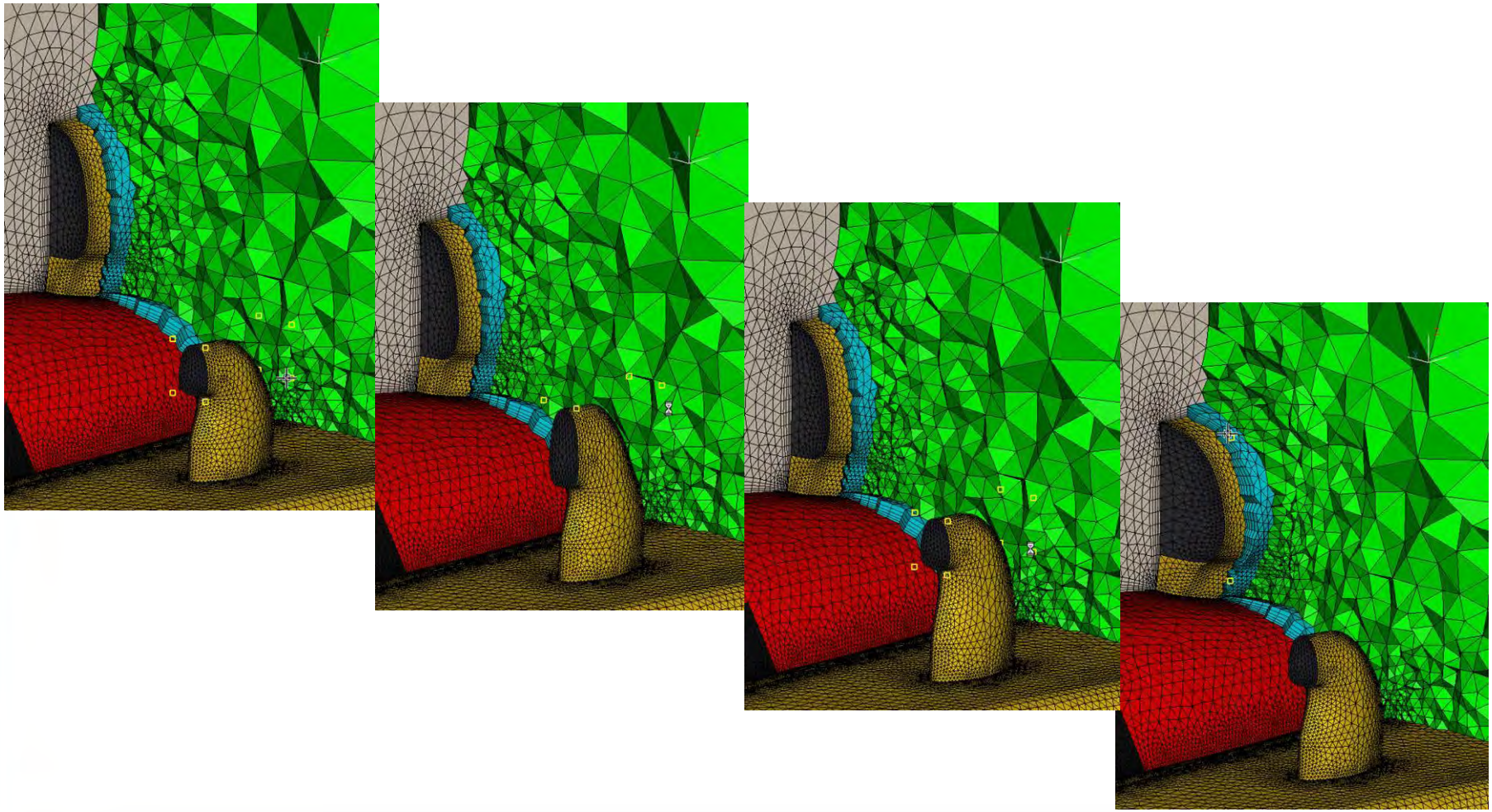
- It is integrated in the same environment so that it can be used in conjunction with the powerful ANSA functionality for geometry handling and surface and volume meshing

- 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

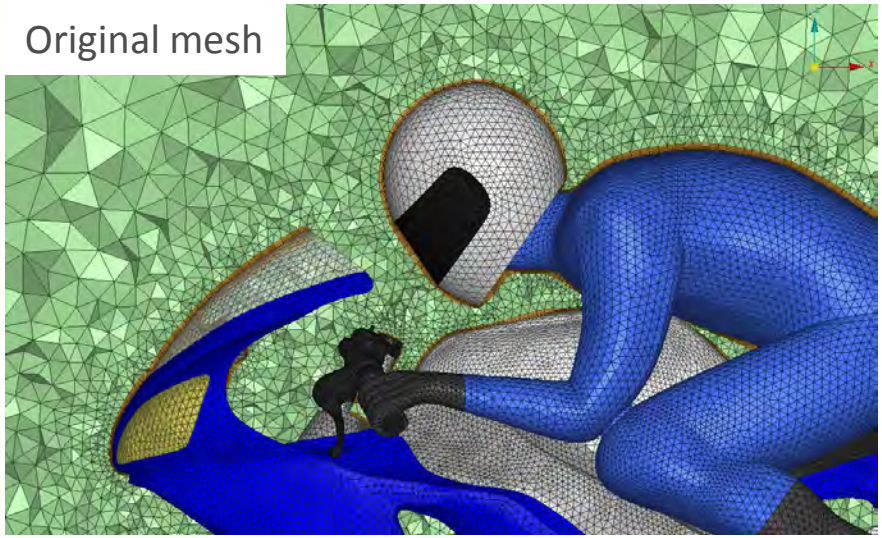
Morphing

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

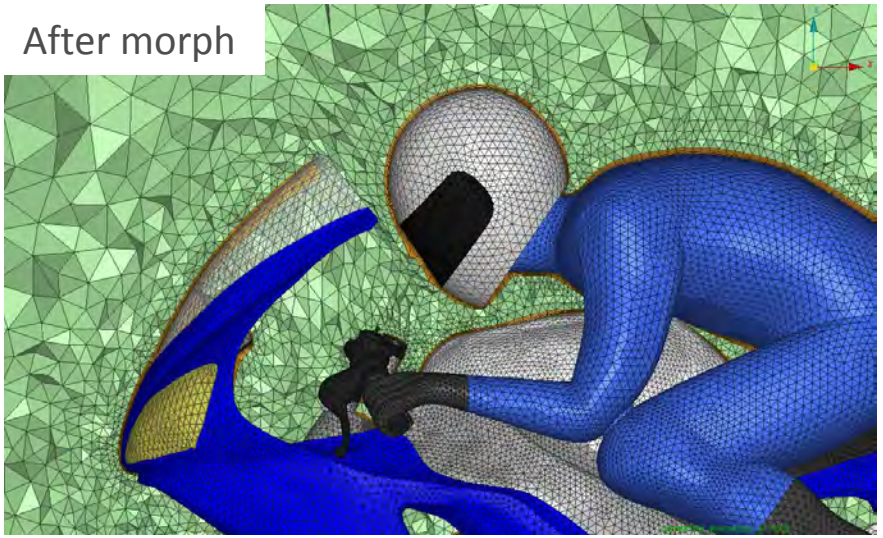


Mesh Reconstruction after large deformations

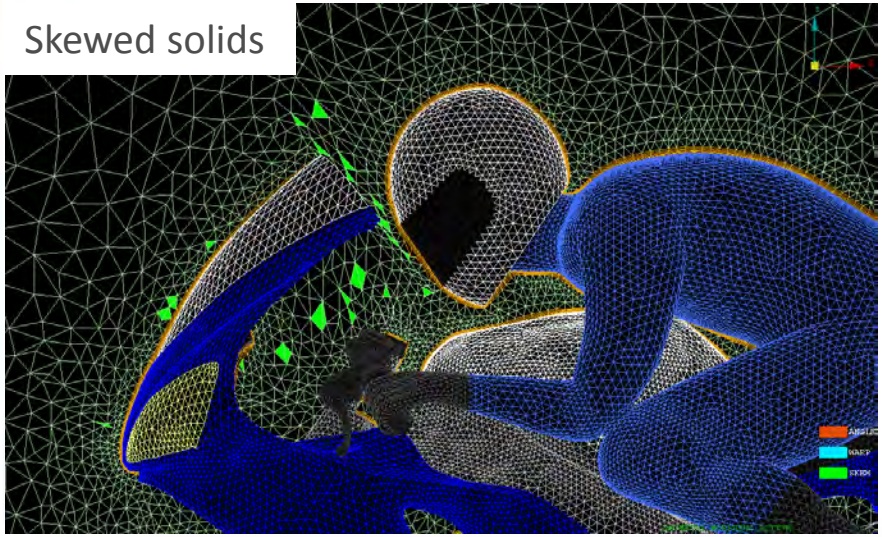
Original mesh



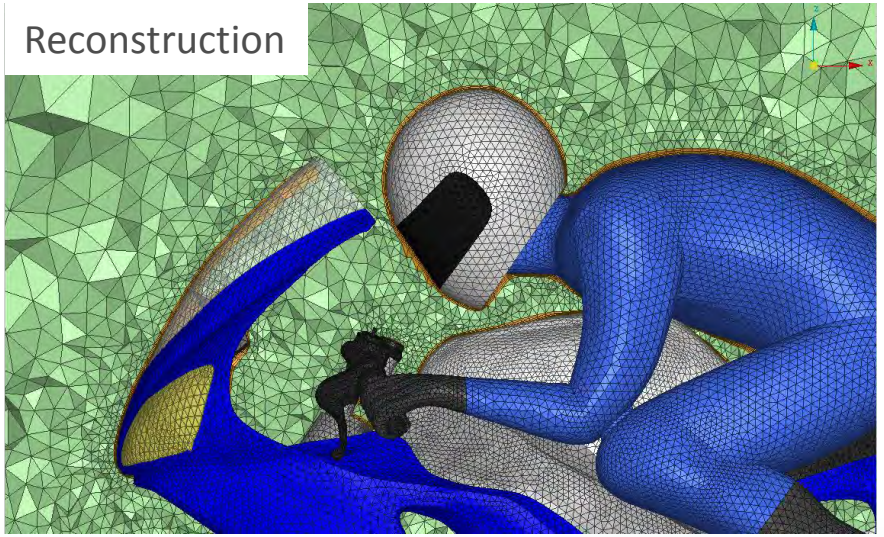
After morph



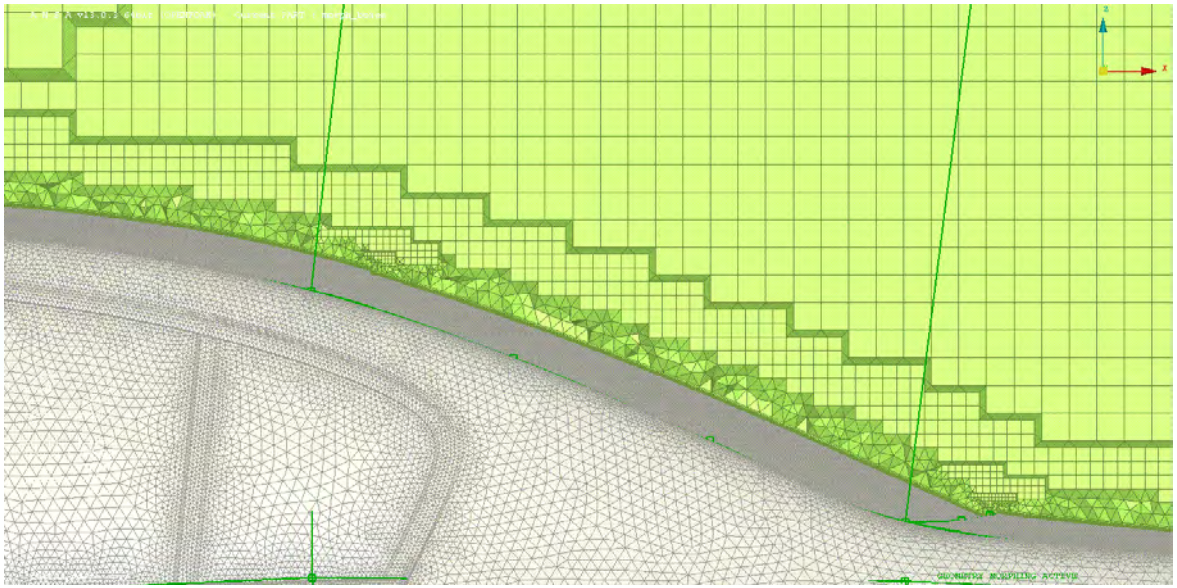
Skewed solids

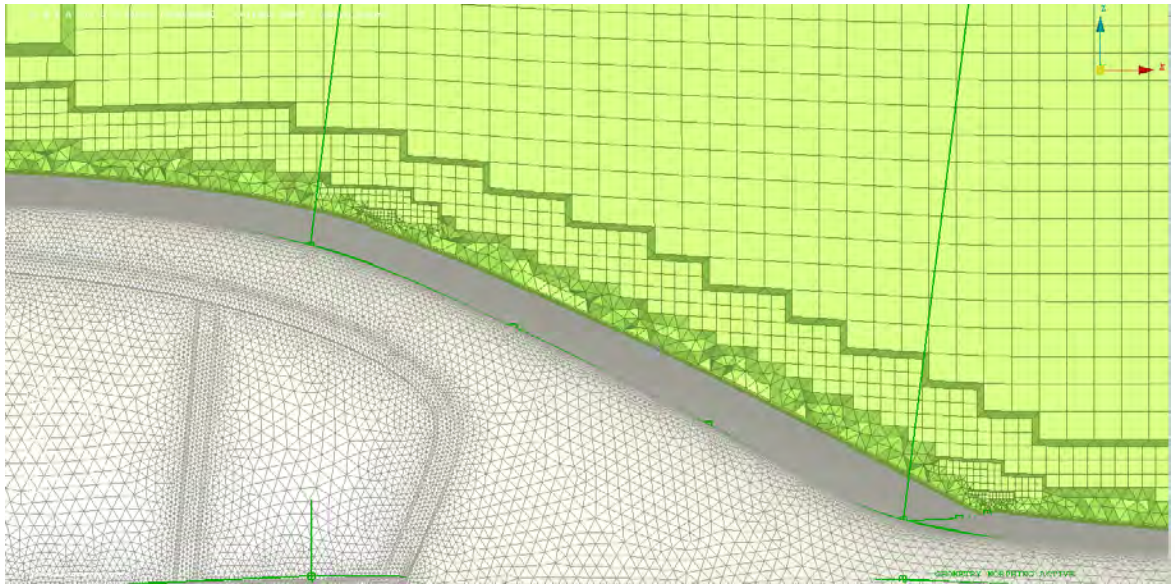


Reconstruction



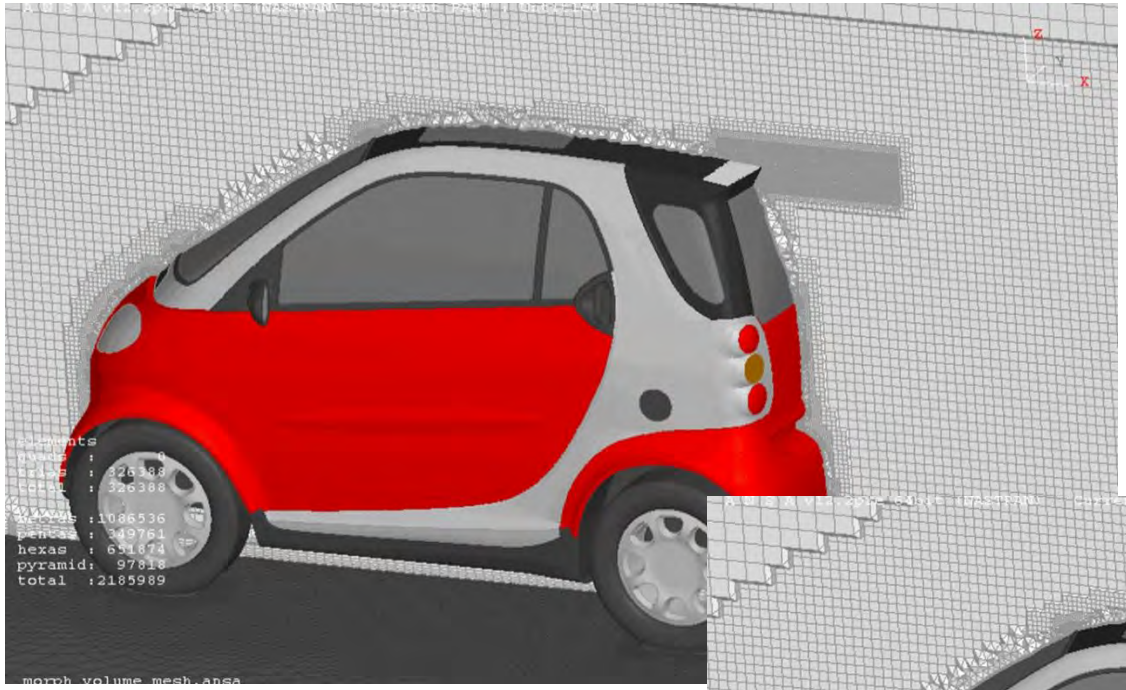
Morphing – Rear windscreen morph

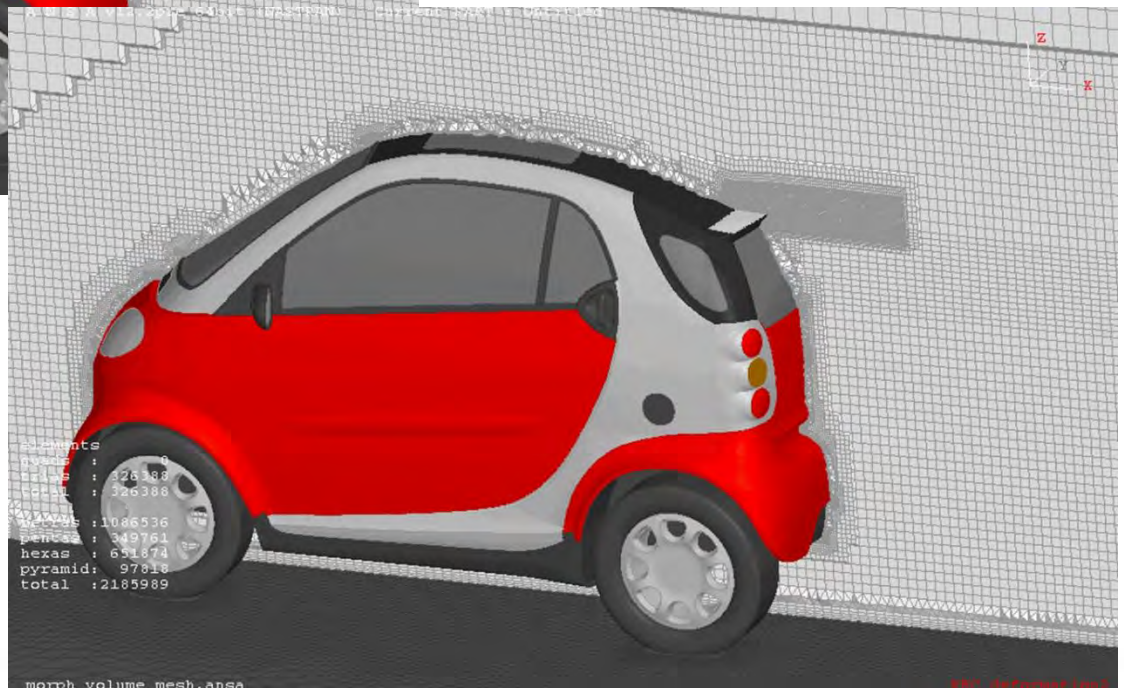




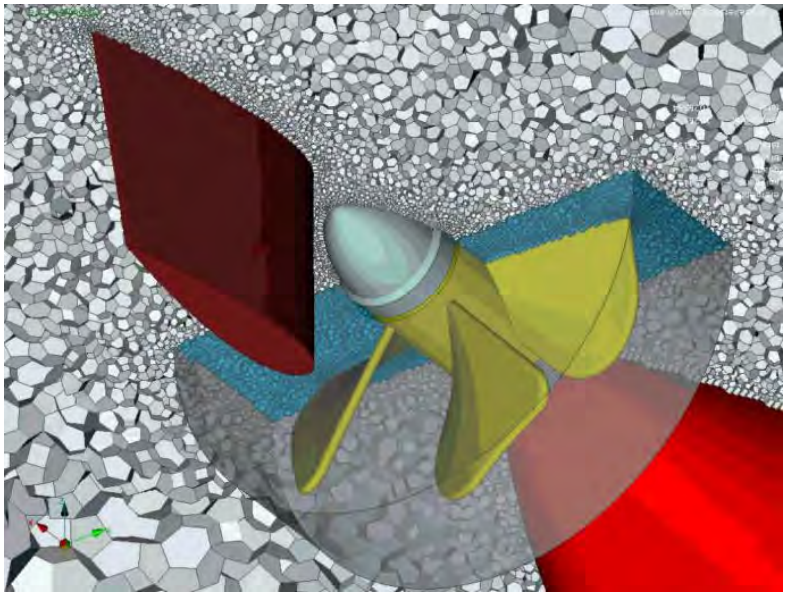
By permission of Volkswagen AG

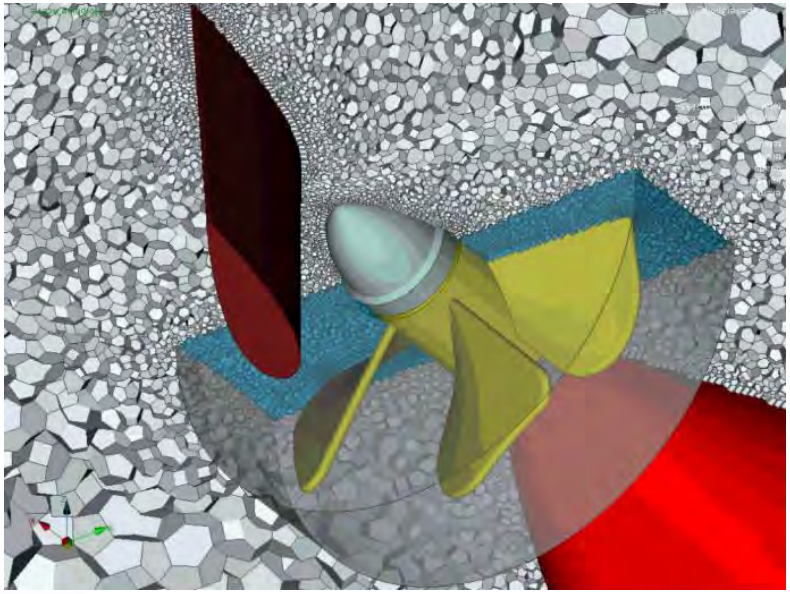
Morphing – External Aero

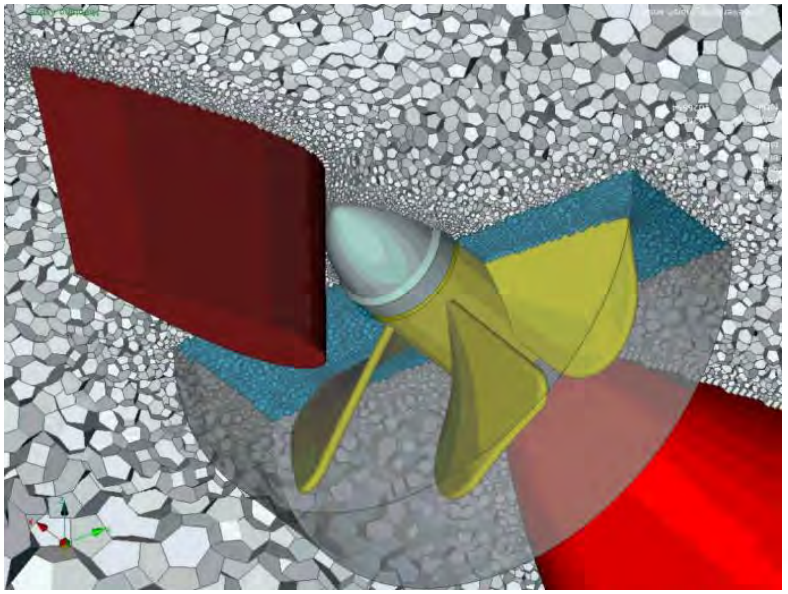




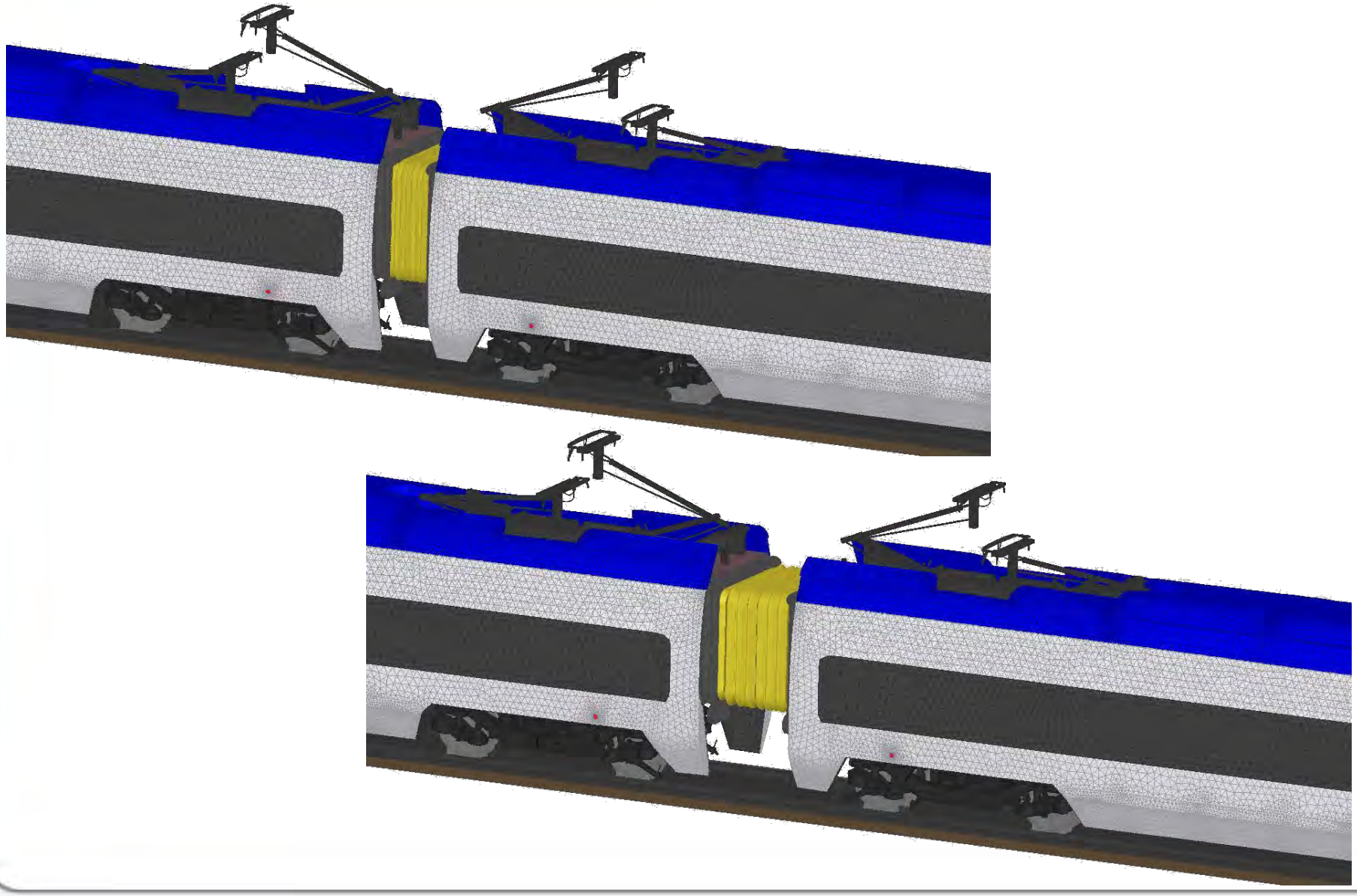
Morphing – rudder angle change



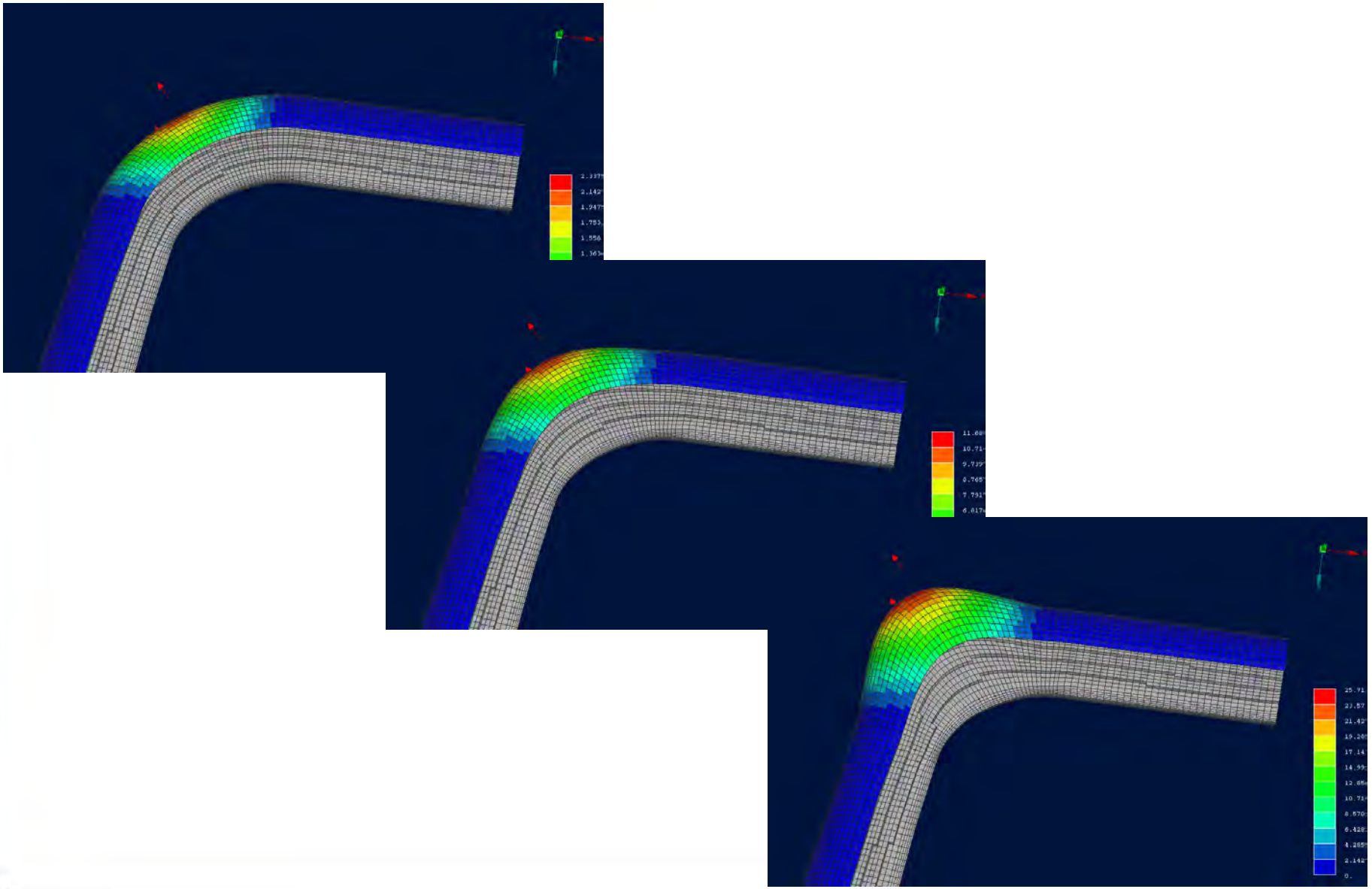




Morphing – External Aero – changing the gap of trains

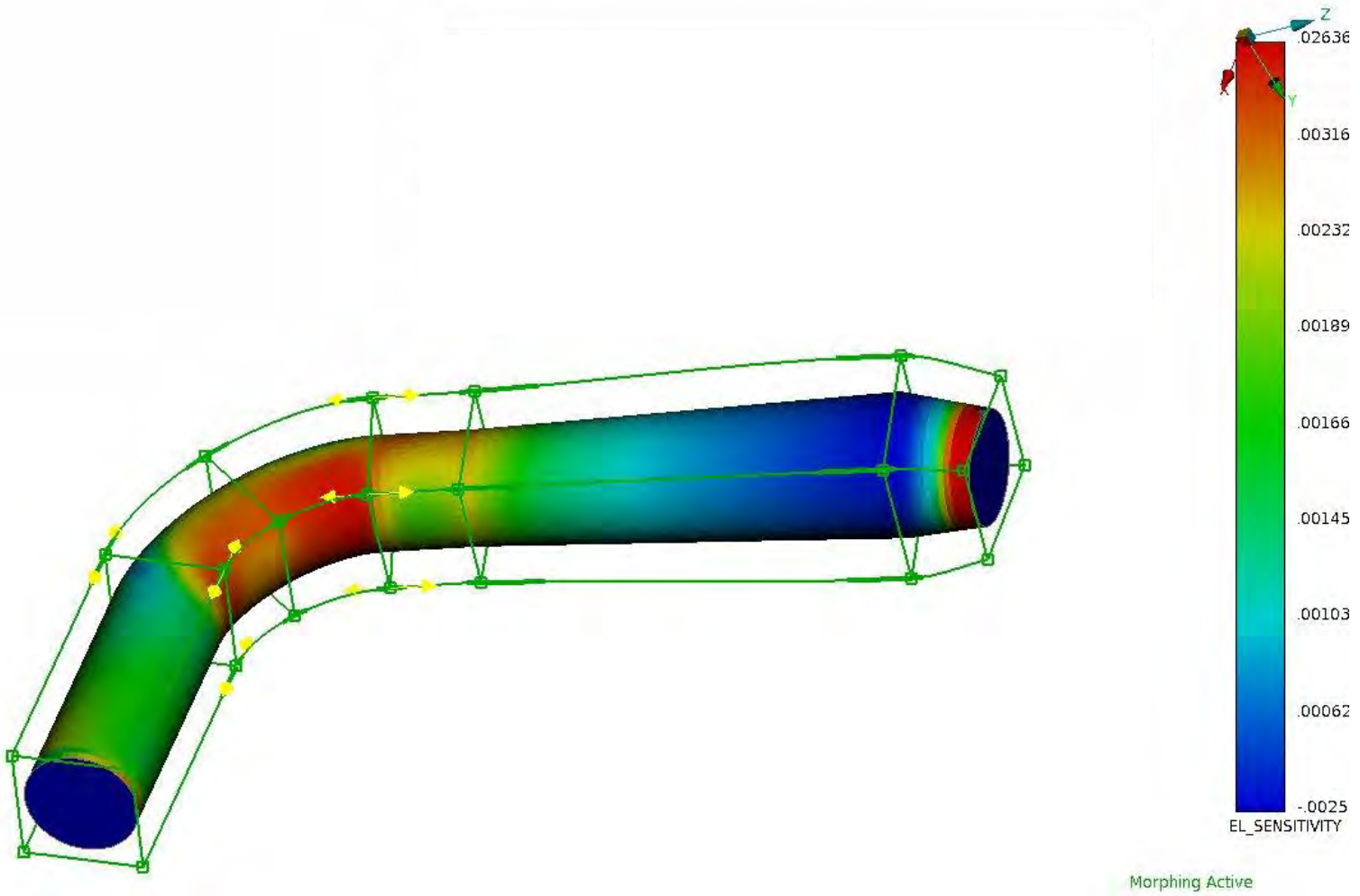


Morphing – Scaling deformations



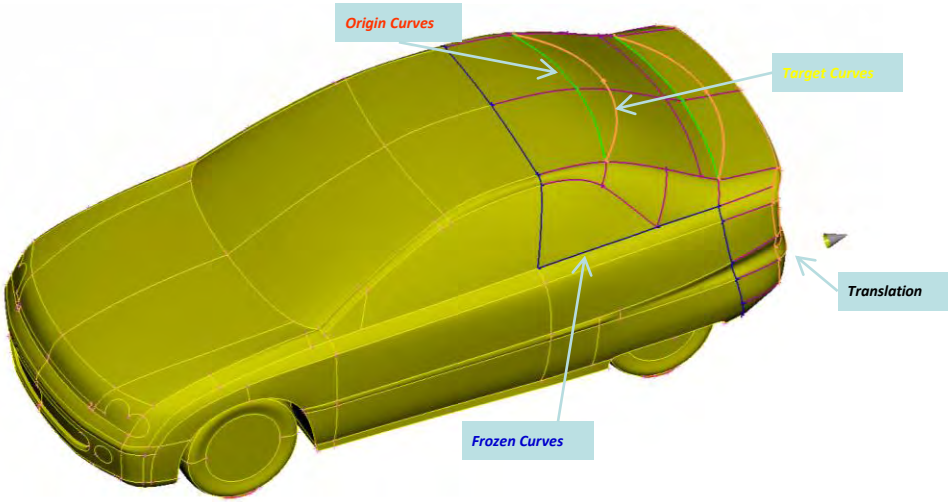
Adjoint solver sensitivity based optimization

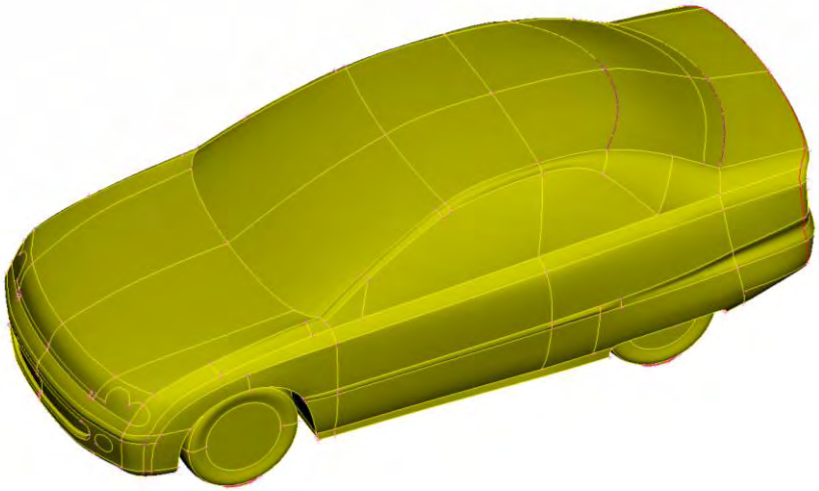
Sensitivity Based optimization with ANSA morphing boxes and parameters that control the motion of morphing points using solver calculated sensitivities

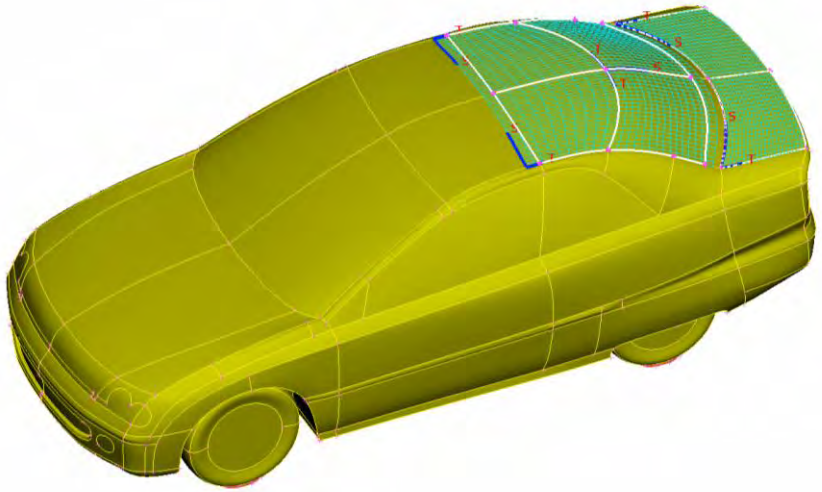


Morphing of Geometry or FE without Boxes

Combinations of snapping of model features to target curves and rigid transformations

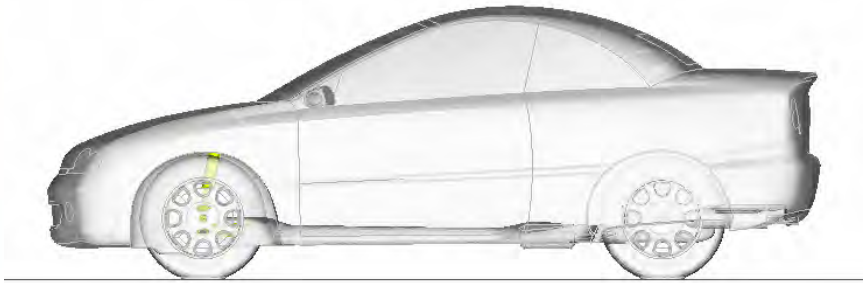


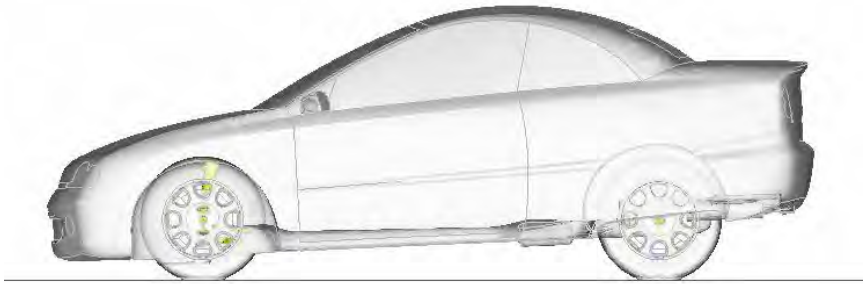


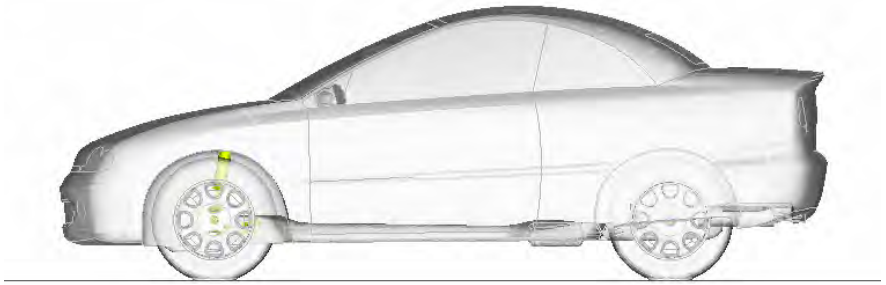


Morphing of Geometry or FE without Boxes: changing the ride height setup

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

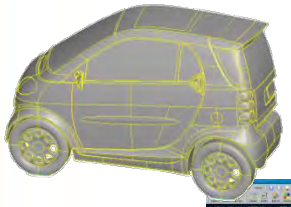




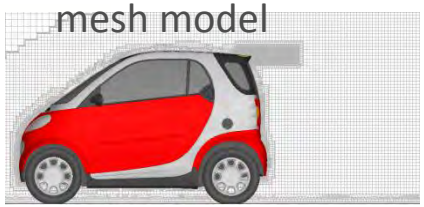


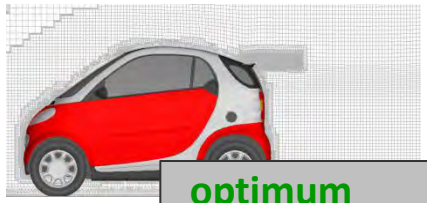
Morphing – Optimization loop

original CAD

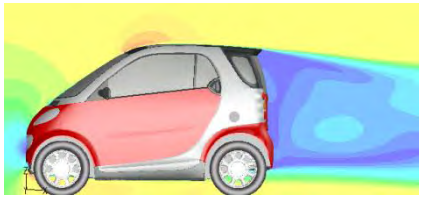


mesh model





optimum
p1,p2,p3

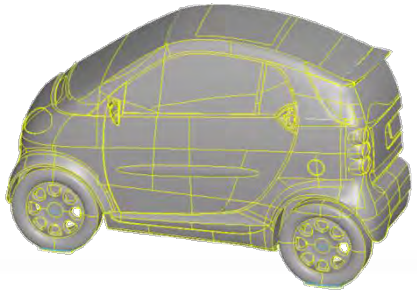


C_L, C_D

p1,p2,p3
.....

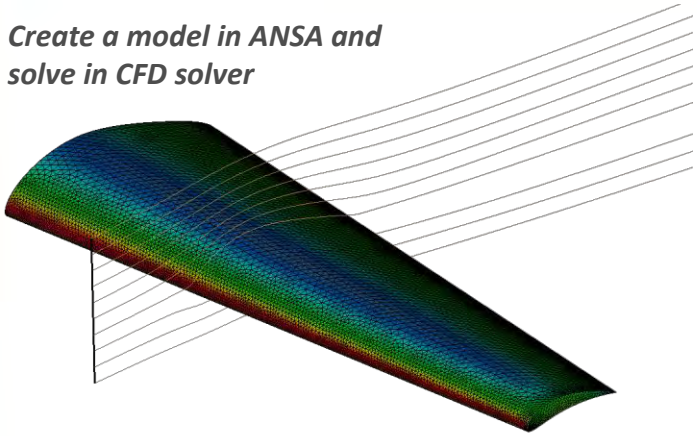
OPTIMIZER

optimized CAD

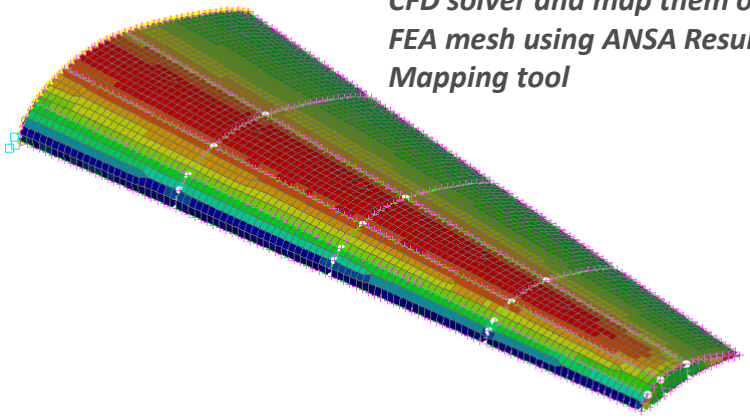


CFD – FEA two way coupling

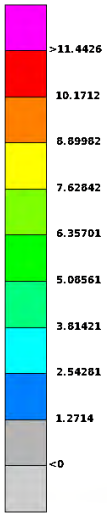
Create a model in ANSA and solve in CFD solver

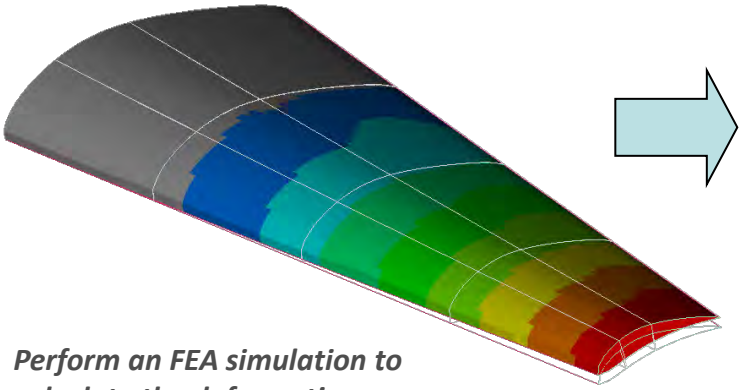


Extract the pressures from the CFD solver and map them on an FEA mesh using ANSA Results Mapping tool

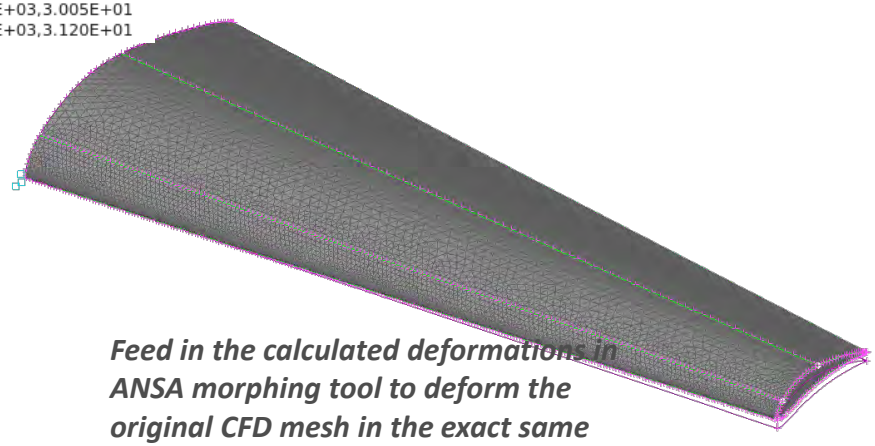


```
Id,Dispx,Dispy,Dispz,posx,posy,posz
1,0.000E+00,0.000E+00,0.000E+00,2.668E+01,-7.650E-05,4.030E+01
2,1.947E-01,1.373E-01,7.191E+00,1.033E+02,-7.499E+02,4.637E+01
2,1.947E-01,1.373E-01,7.191E+00,1.033E+02,-7.499E+02,4.637E+01
3,3.121E-01,-1.953E-03,1.112E+01,7.755E+01,-1.000E+03,4.157E+01
3,3.121E-01,-1.953E-03,1.112E+01,7.755E+01,-1.000E+03,4.157E+01
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
```





Perform an FEA simulation to calculate the deformations

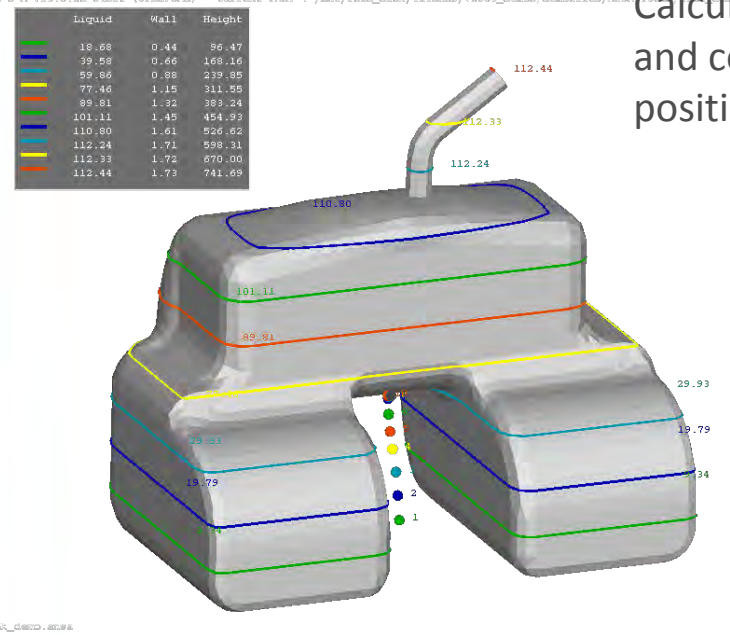


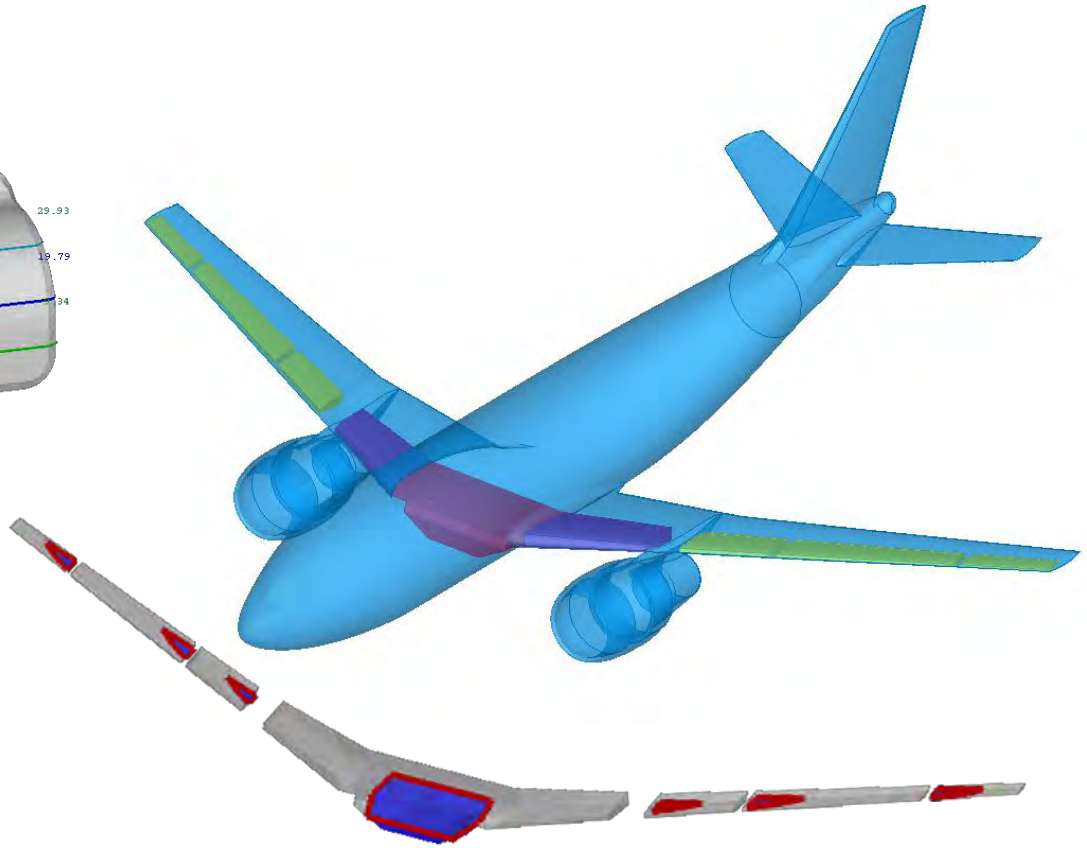
Feed in the calculated deformations in ANSA morphing tool to deform the original CFD mesh in the exact same manner

Liquid Level Calculations

Fuel and resting liquid calculations

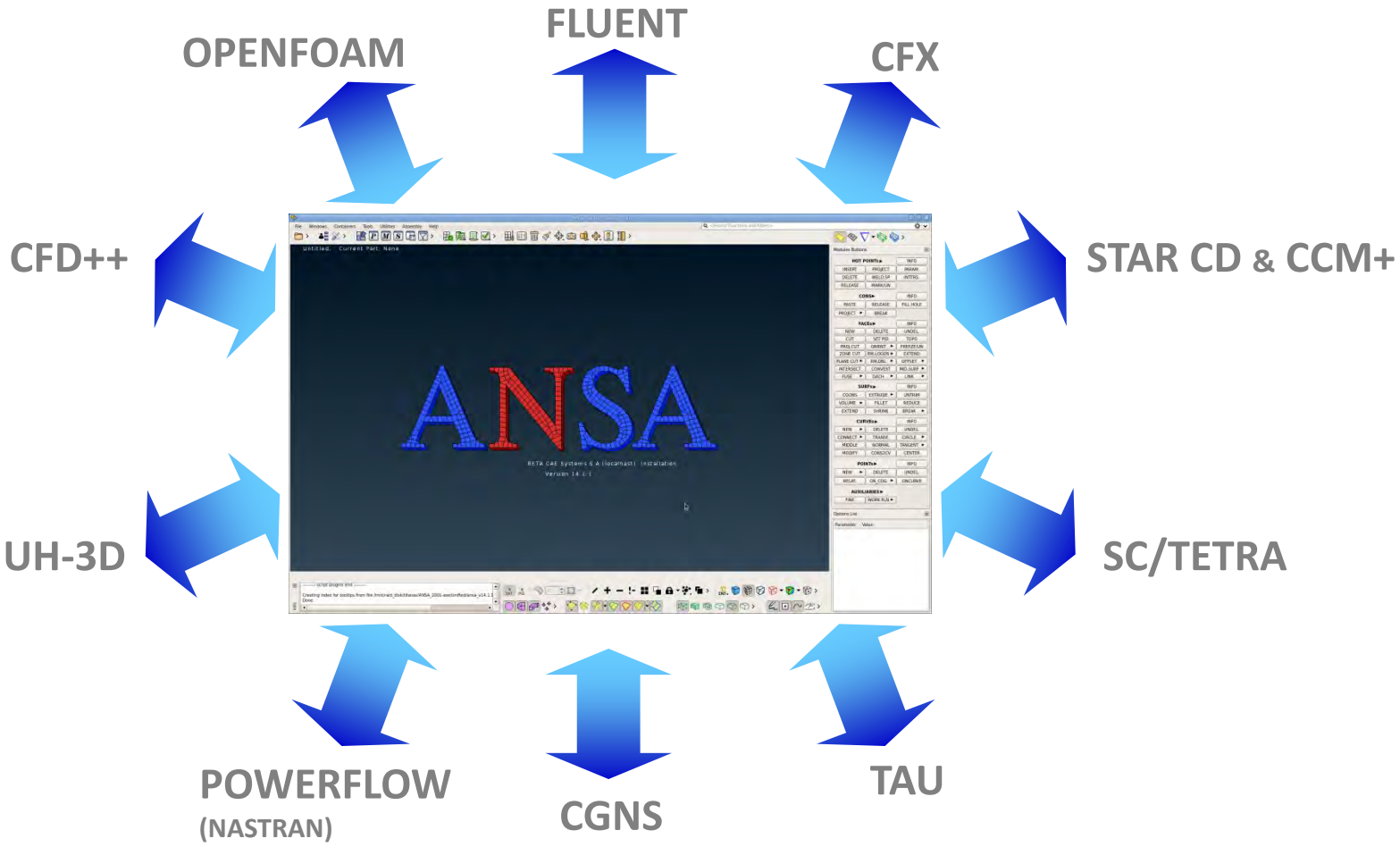
Calculation of liquid volume, levels
and centre of gravity for various tank configurations and positions





Unused liquid traps

One common pre-processing platform for several codes



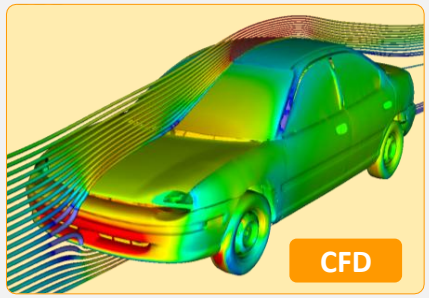
NASTRAN, ABAQUS, ANSYS,
RADTHERM, THESEUS-FE and more…

About µETA post-processor

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

Basic concepts and features:

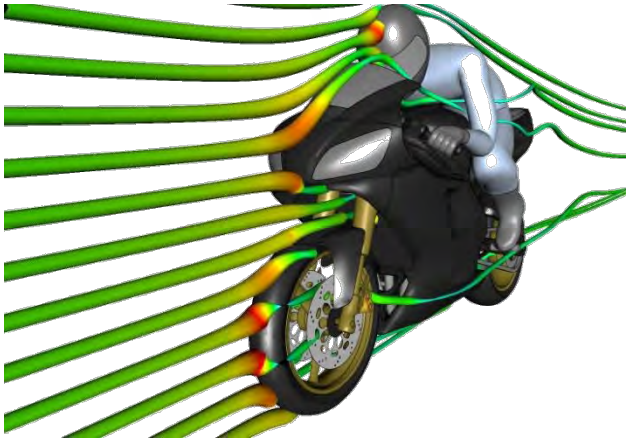
- Powerful tools for 3D & 2D Post Processing for all disciplines
- High performance graphics
- Low memory footprint
- Best-in-class multi-model handling
- Generation of high-quality reports
- Outstanding automation capabilities



From solver results to report

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

Supported formats



Ansys Fluent

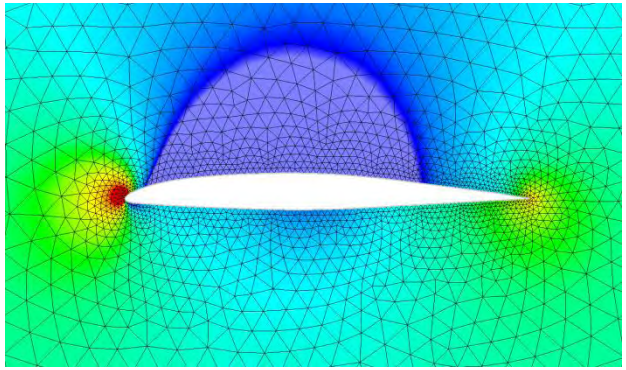
- Fluent 2d and 3d *.msh, *cas, *dat
- CFDpost compatible *.cdat

OpenFOAM

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

StarCCM+

- *.ccm and *.sim files



CFD++

SC/Tetra

Ansys CFX

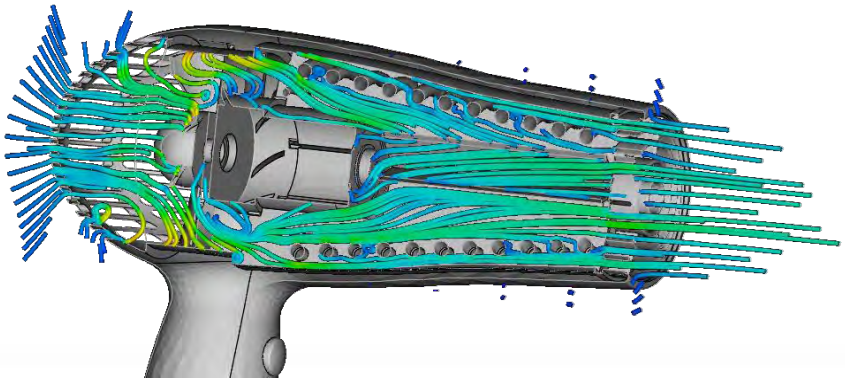
Ensight

Tecplot

Fieldview

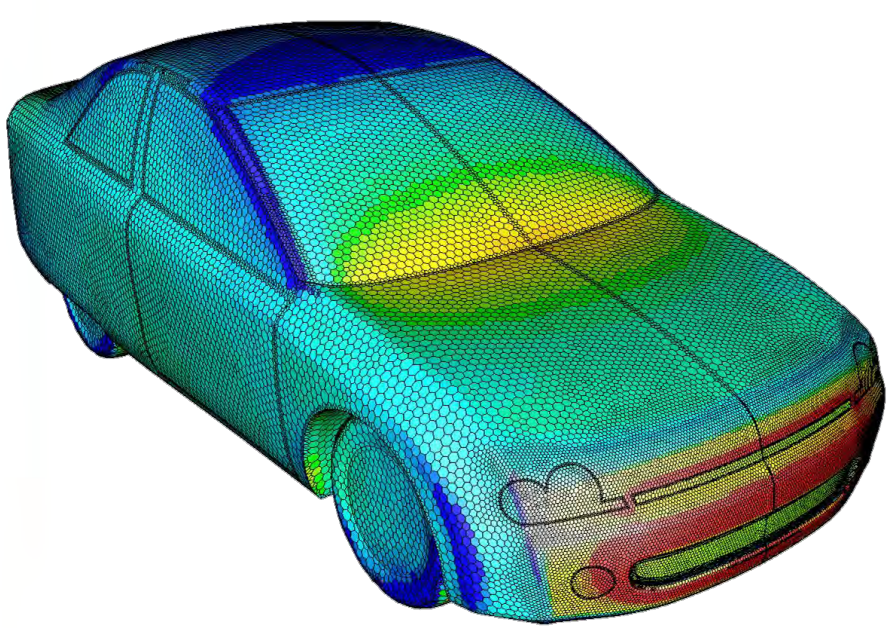
Radtherm

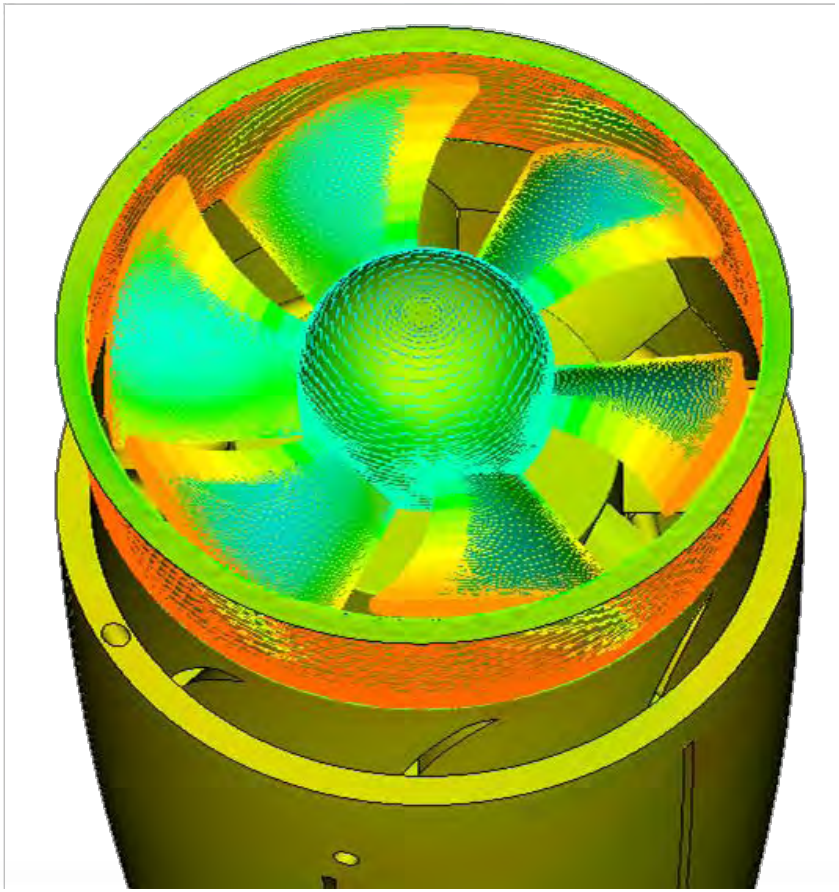
Theseus- FE



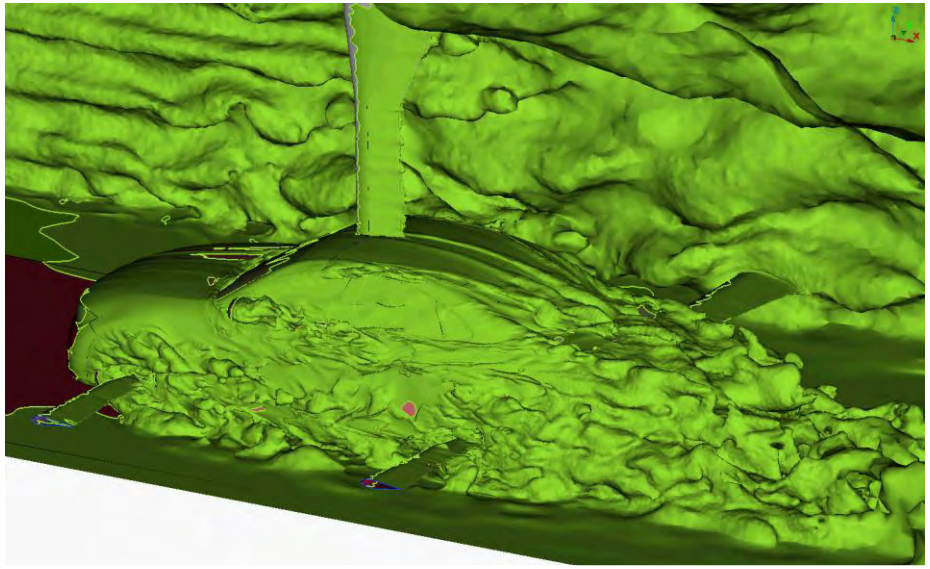
Supported Features

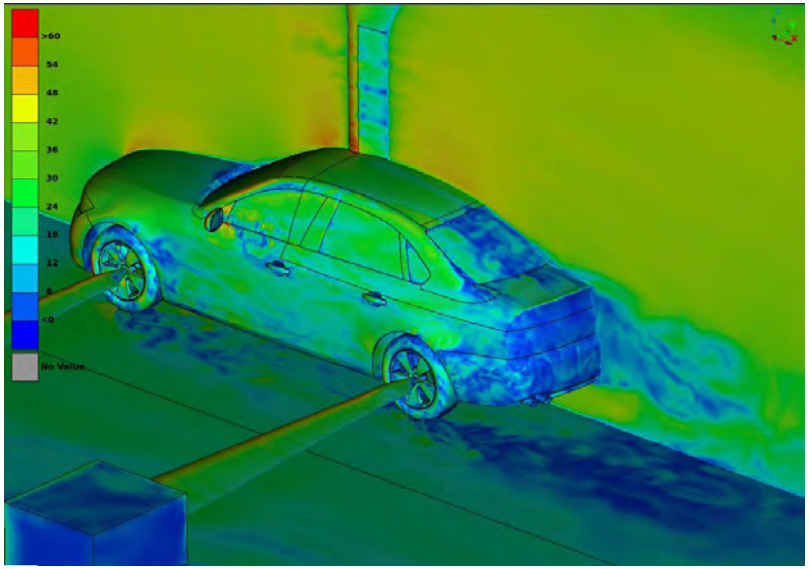
- Standard and Polyhedral elements
- Steady state and transient results
- MRF (multiple reference frame) zones and moving mesh

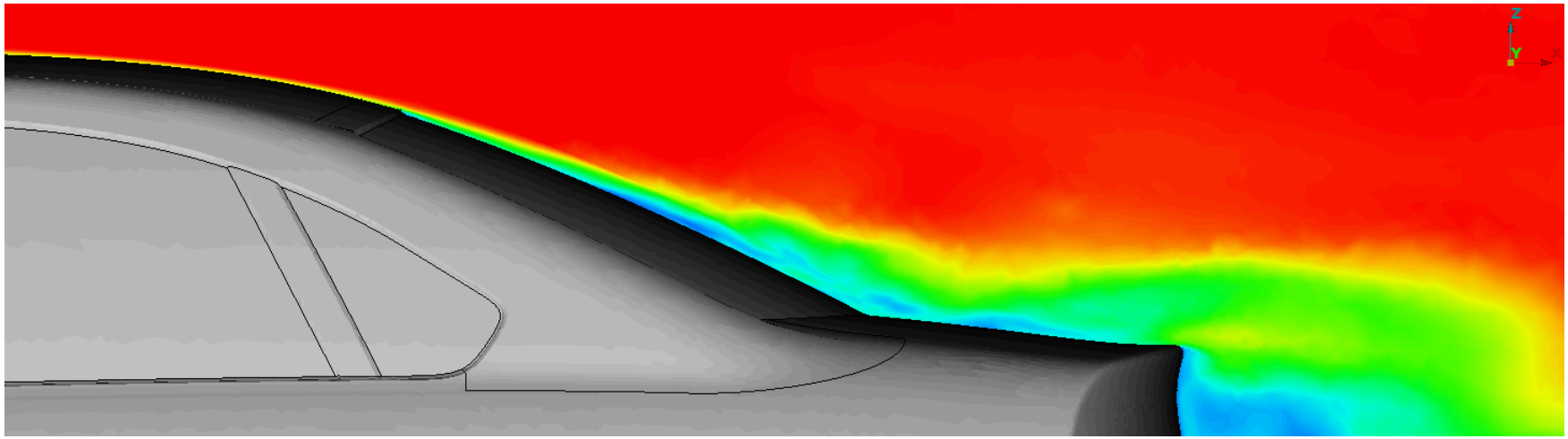




Visualization of Cut Planes and Iso-Surfaces

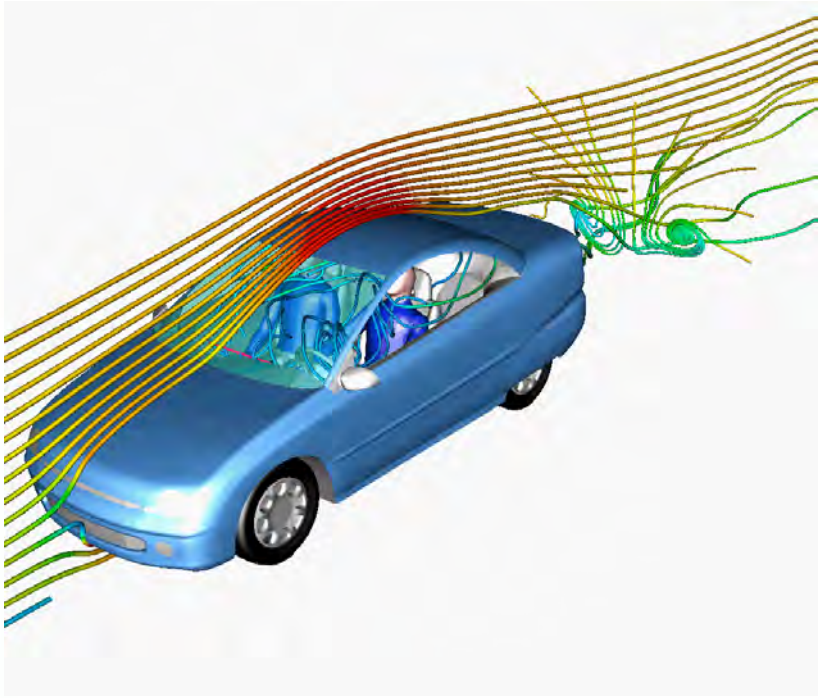


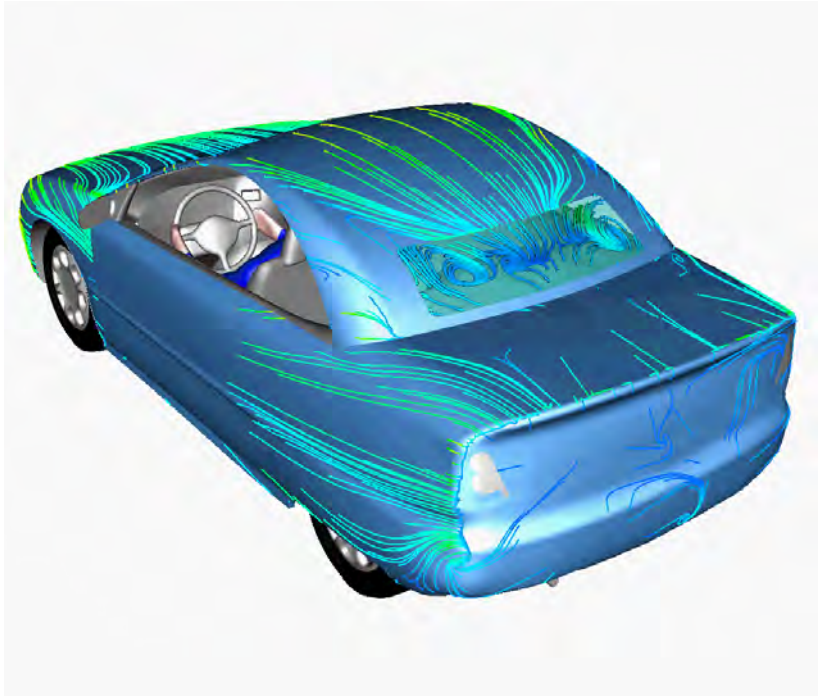




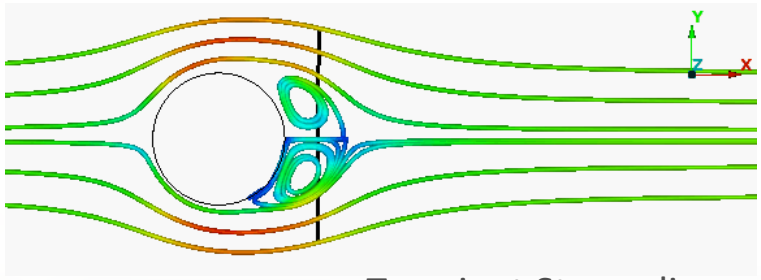
DrivAer model courtesy of Technical University of Munich

Visualization of Streamlines and Oil-flow paths

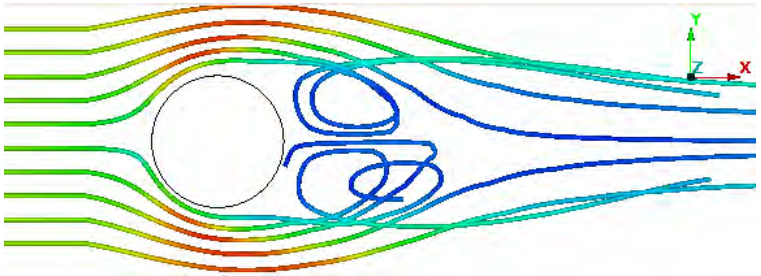




Creation of Streamlines and Pathlines for transient analyses

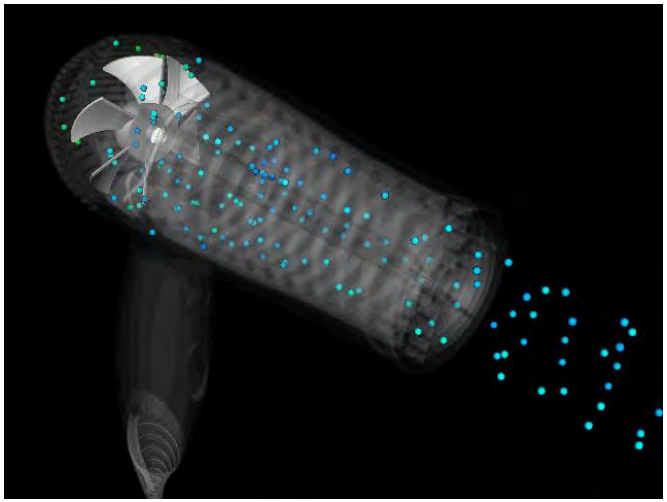


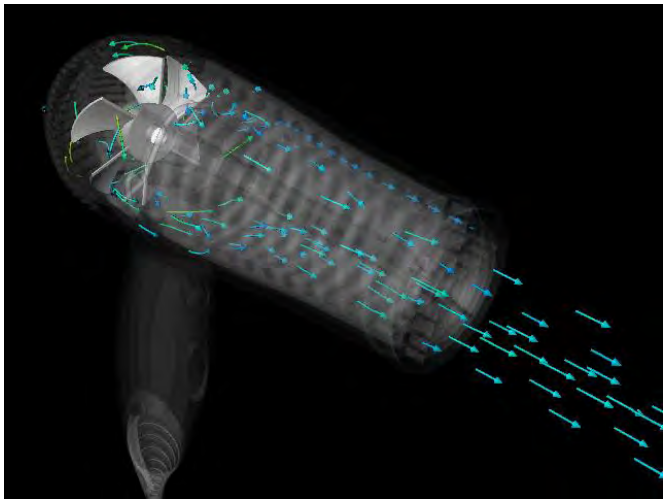
Transient Streamlines

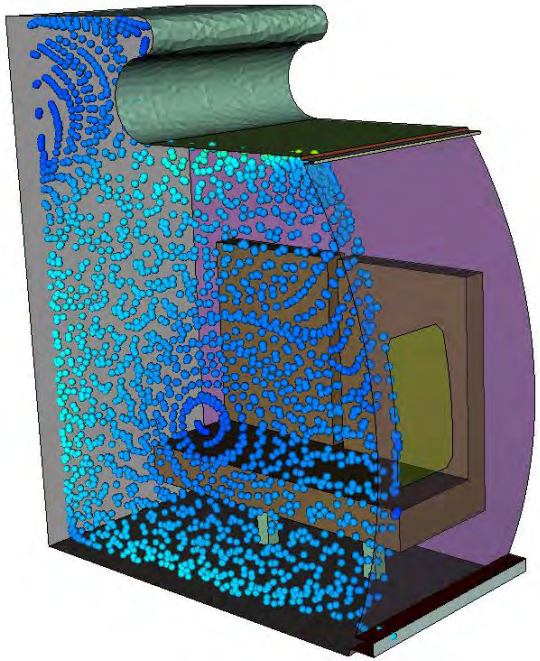


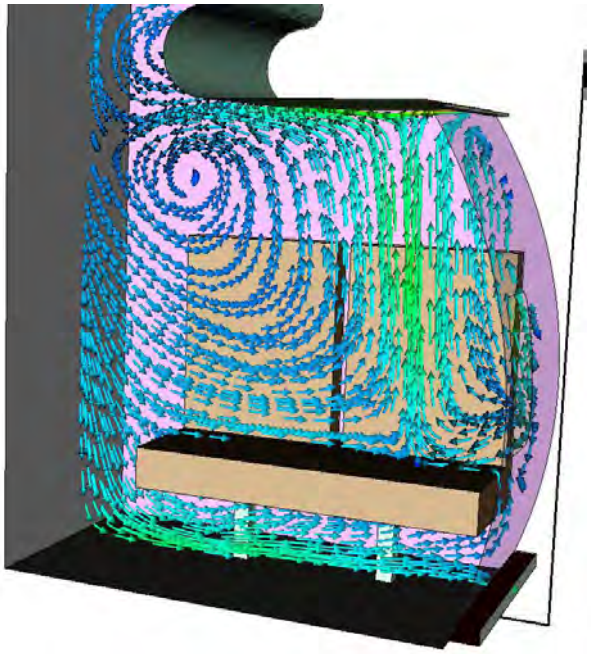
Pathlines

Multiple streamline visualization options





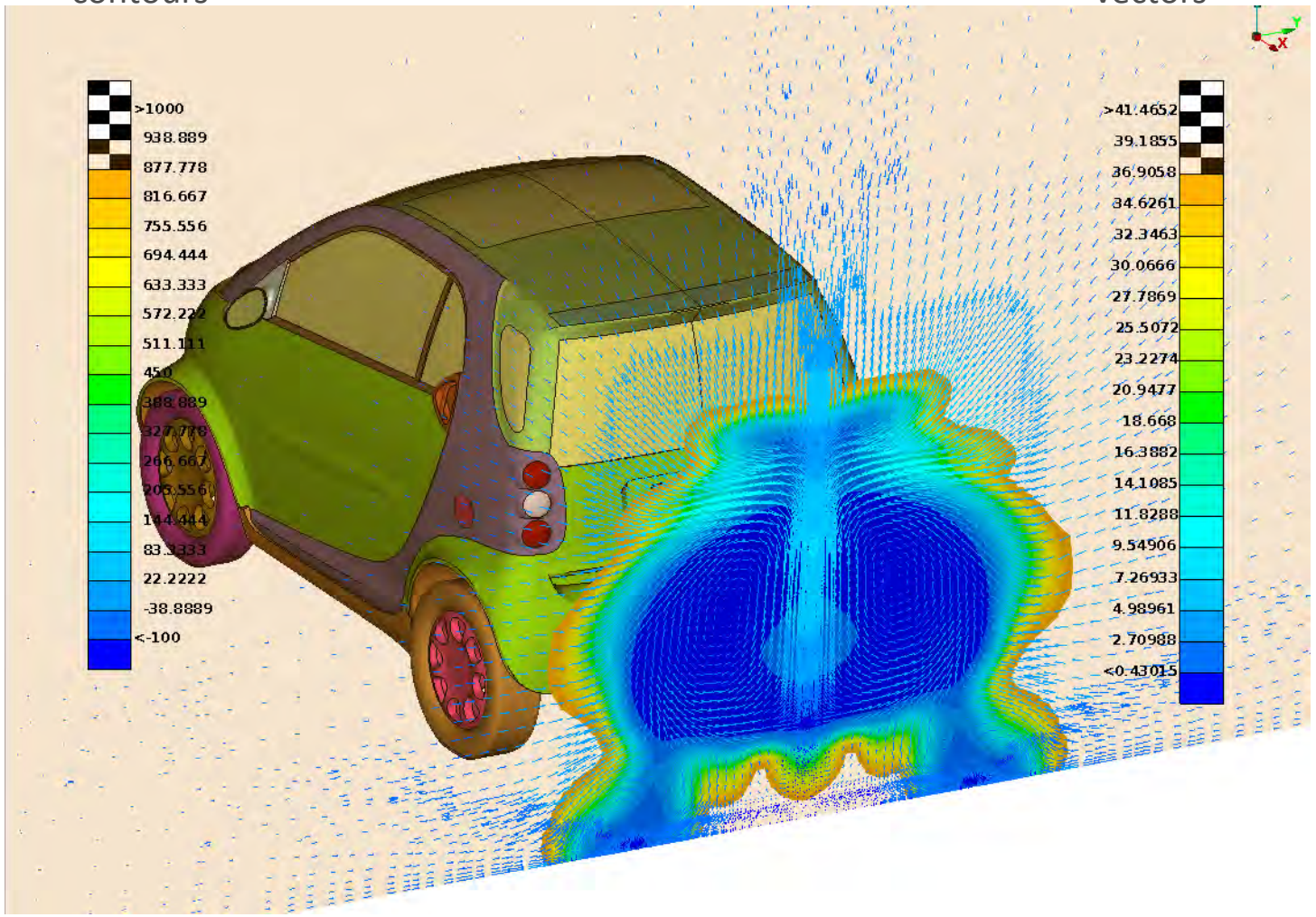




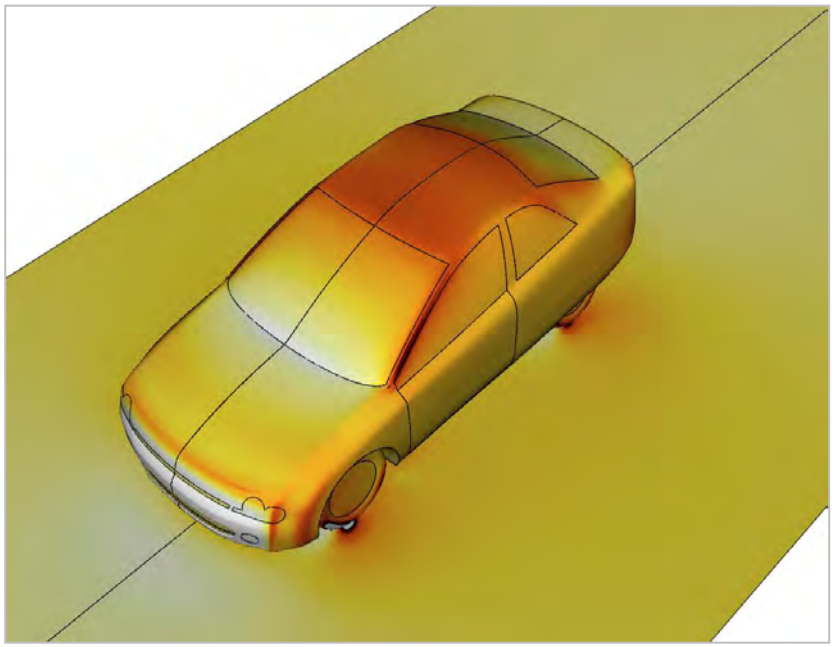
Double fringe bars for simultaneous display of contour and vector data

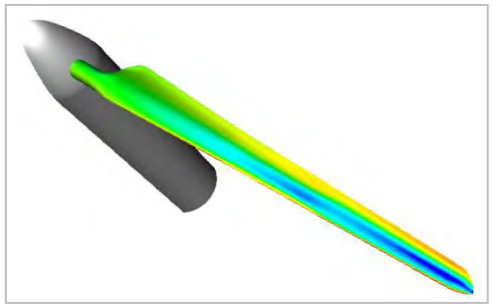
Total pressure contours

Velocity vectors



Symmetric and periodic display of results





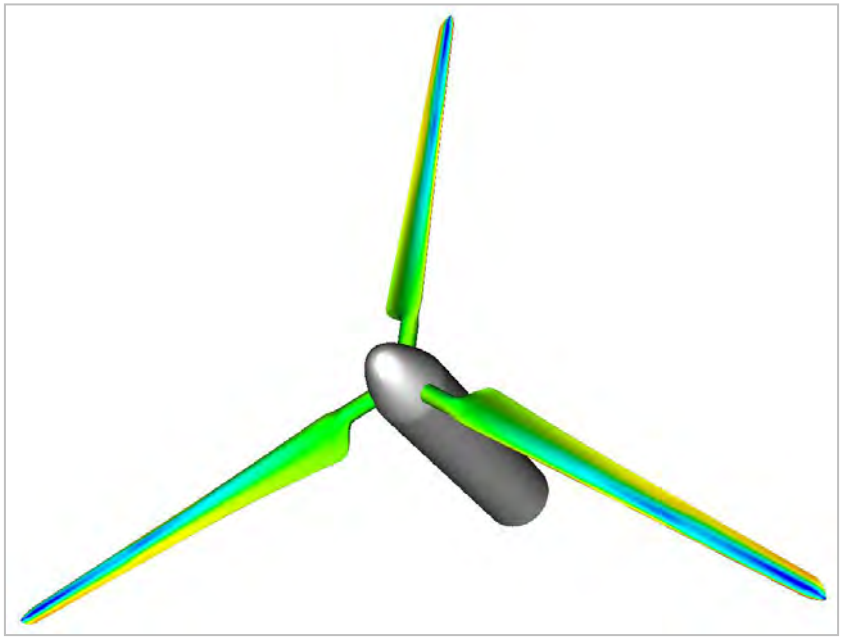
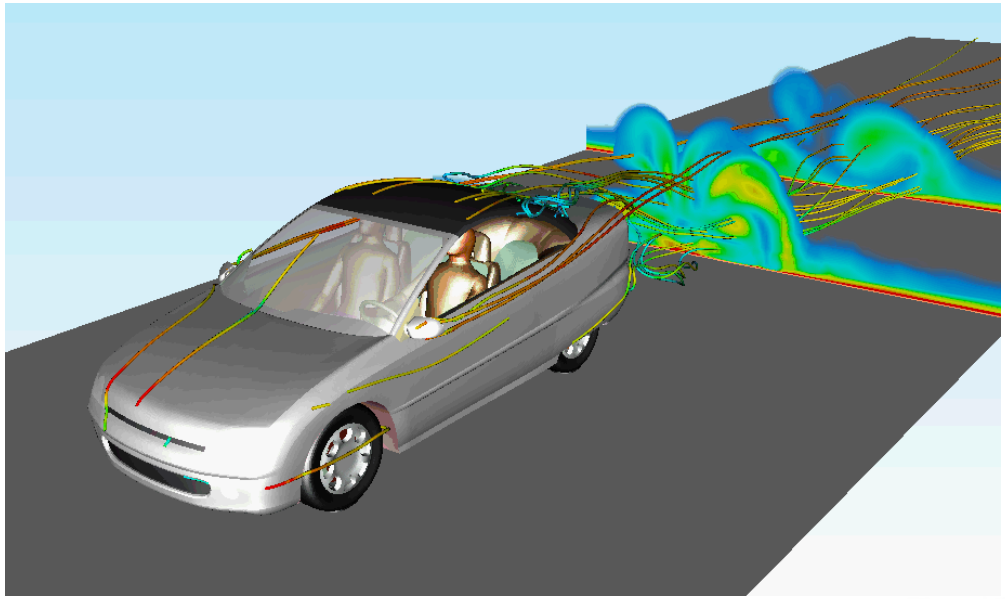
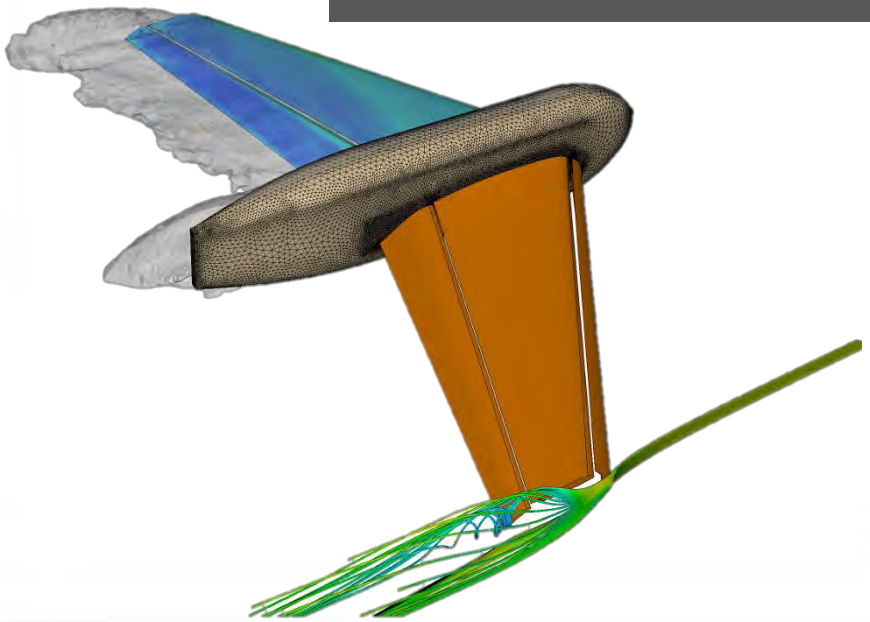


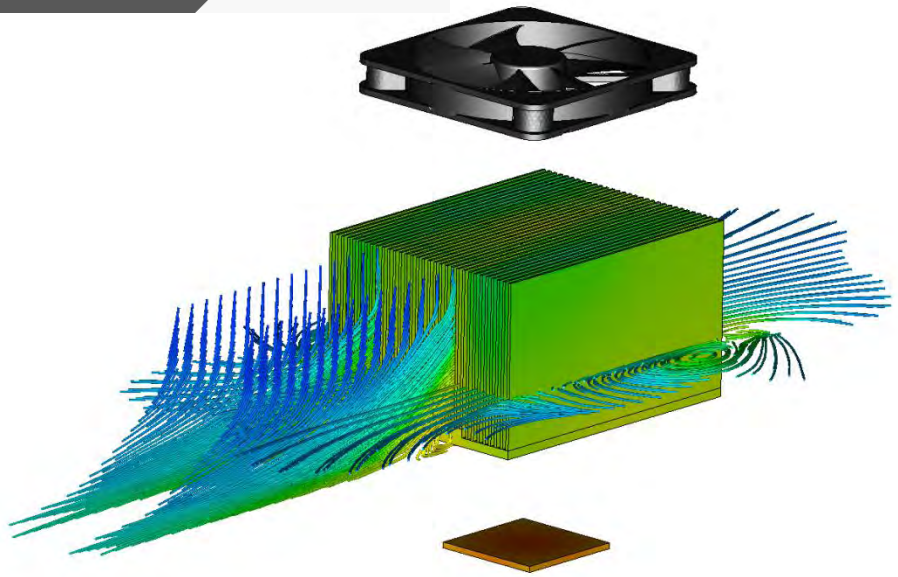
Image and video output in numerous formats

- JPEG
- PNG
- TIFF
- BMP
- GIF
- PS
- EPS



- MPEG
- AVI
- Animated GIF



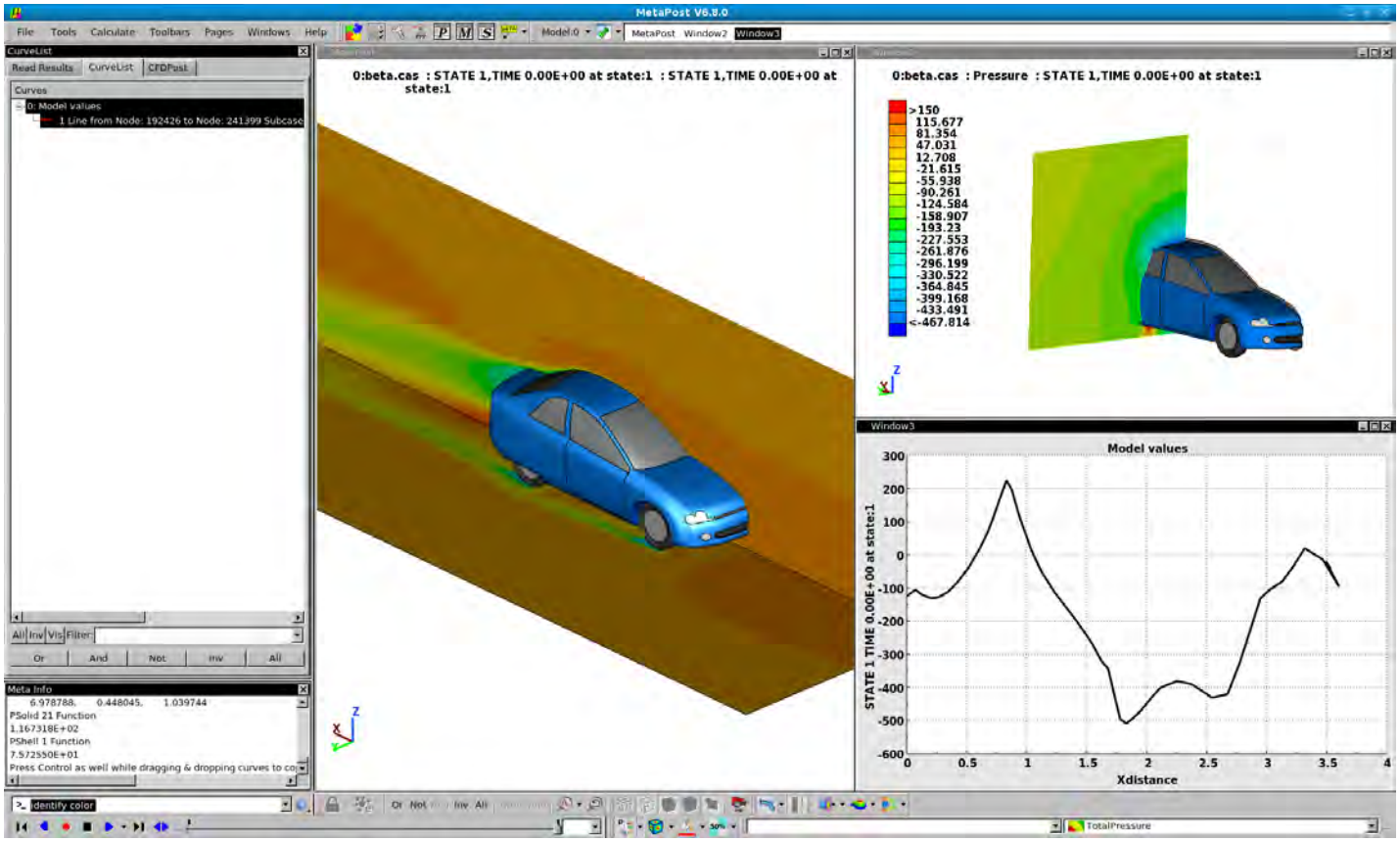


Camera Match tool

Correlate physical images and videos with CFD results

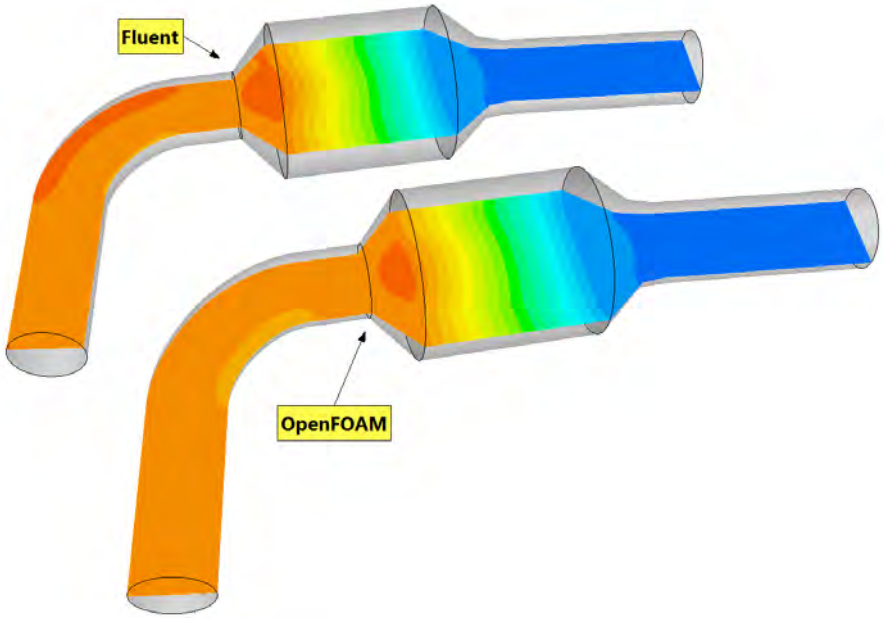
Multi Windows

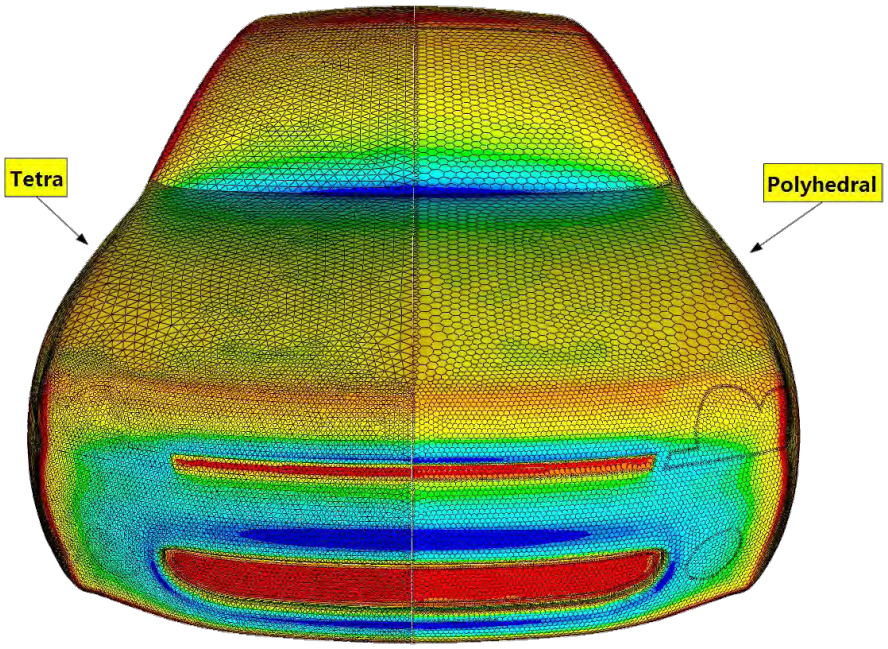
- 3d and 2d windows
- Setup styles and entities visibility per window
- Different models can be placed in one or more windows



Model comparison

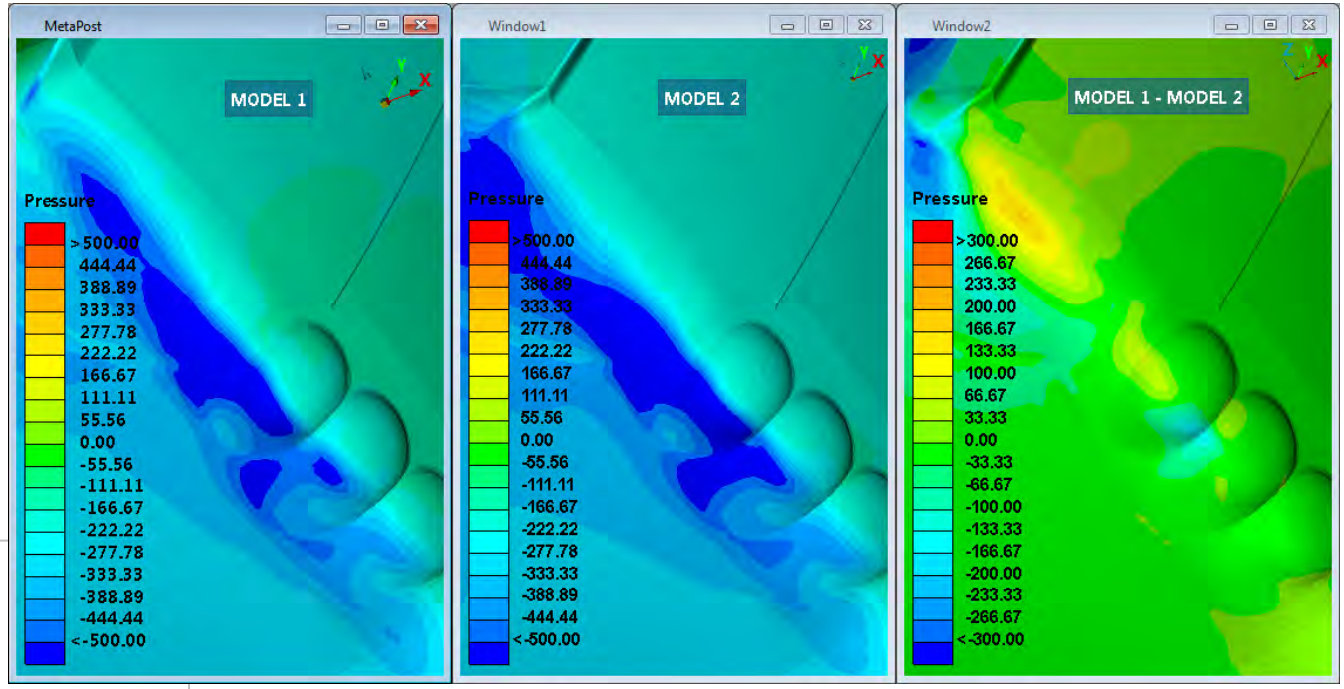
Load multiple models and compare cases from different solvers, meshes, physical models and numerical setups

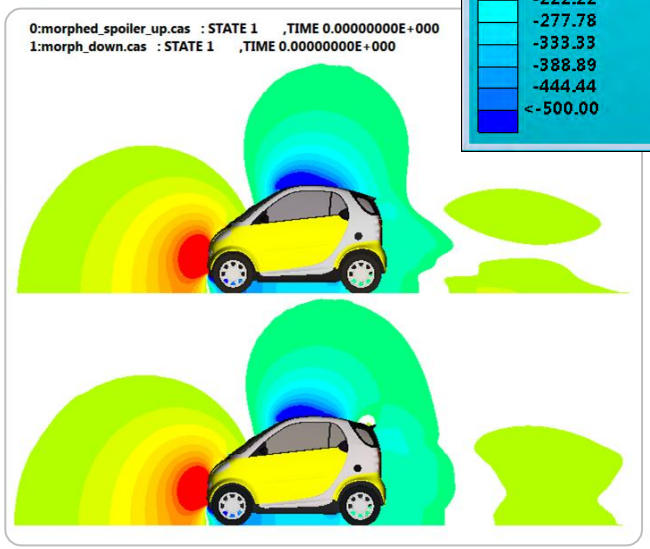




Model Comparison

Map results from one model to another and calculate their differences

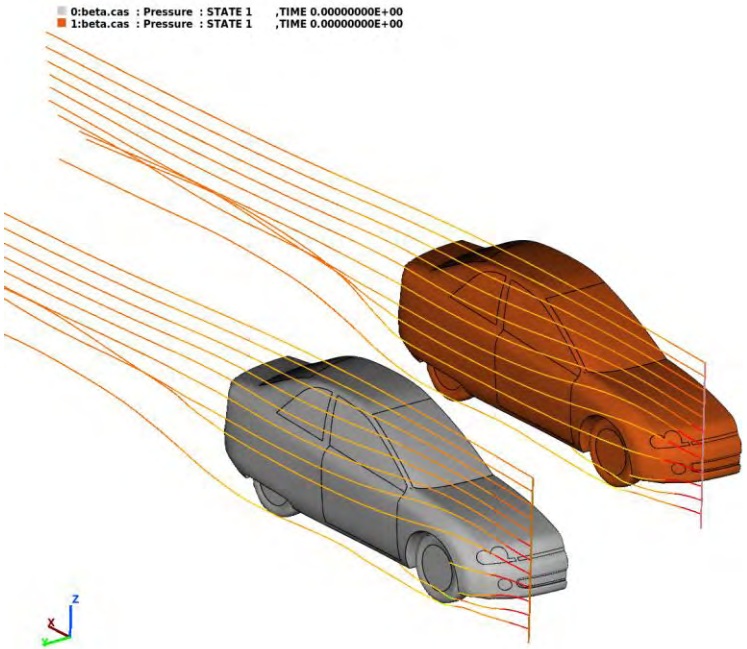




Model Overlay

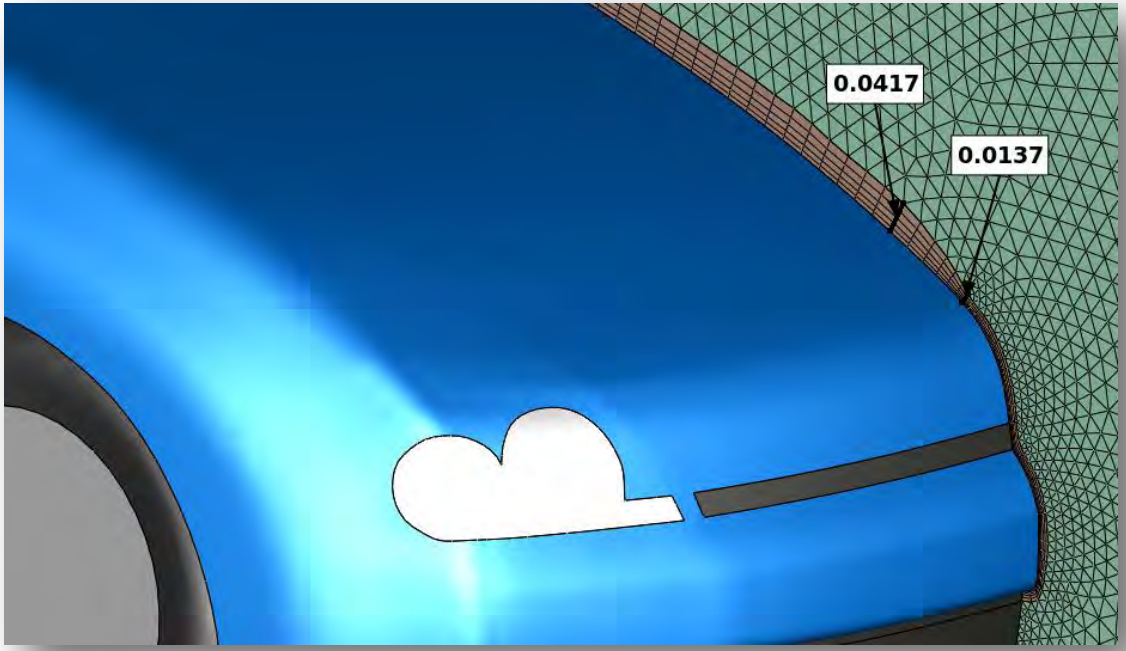
Overlay and compare multiple iterations of data

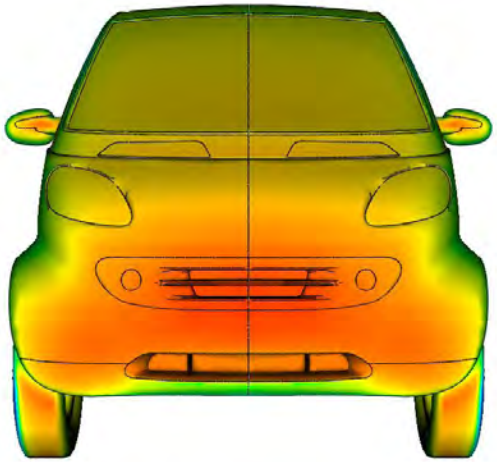
- Set the respective files or paths of the second model
- All new data are automatically overlaid on the respective windows



Query of model dimensions

- Measurement of distances
- Projected Area measurement

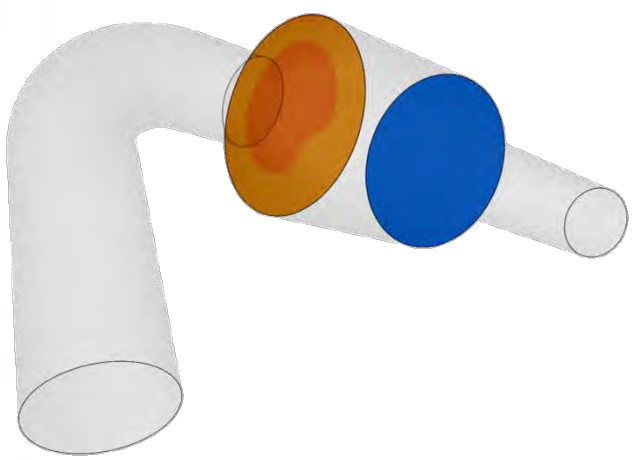




Projected Area: 1.884

Calculations

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

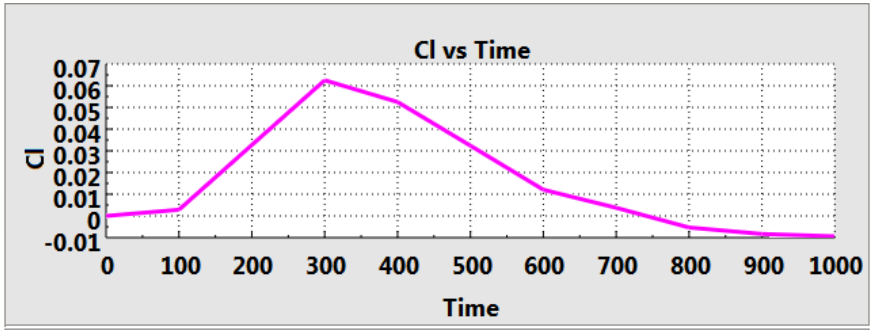


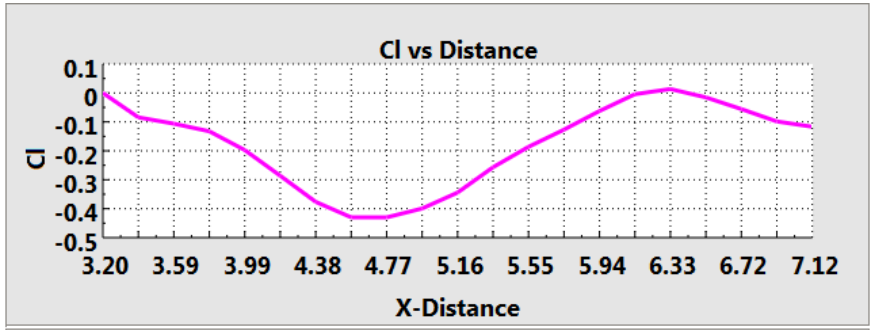
Surface Integrals

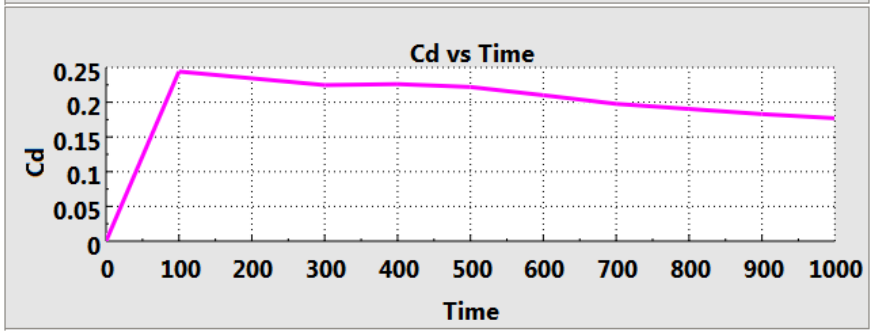
Pid	Name	Area Weighted Average
2	interior_downstream_cat	1187.68000
3	interior_upstream_cat	17057.3000
	Sum	18244.98
	Avg	9122.49
	Diff	15869.62

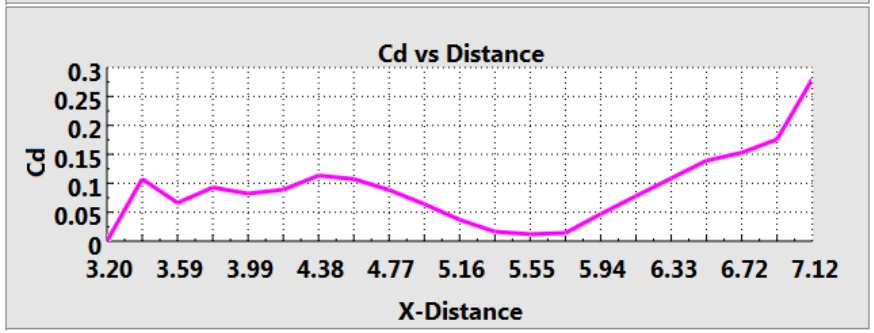
Plots

Cd/Cl plots vs Time/Distance



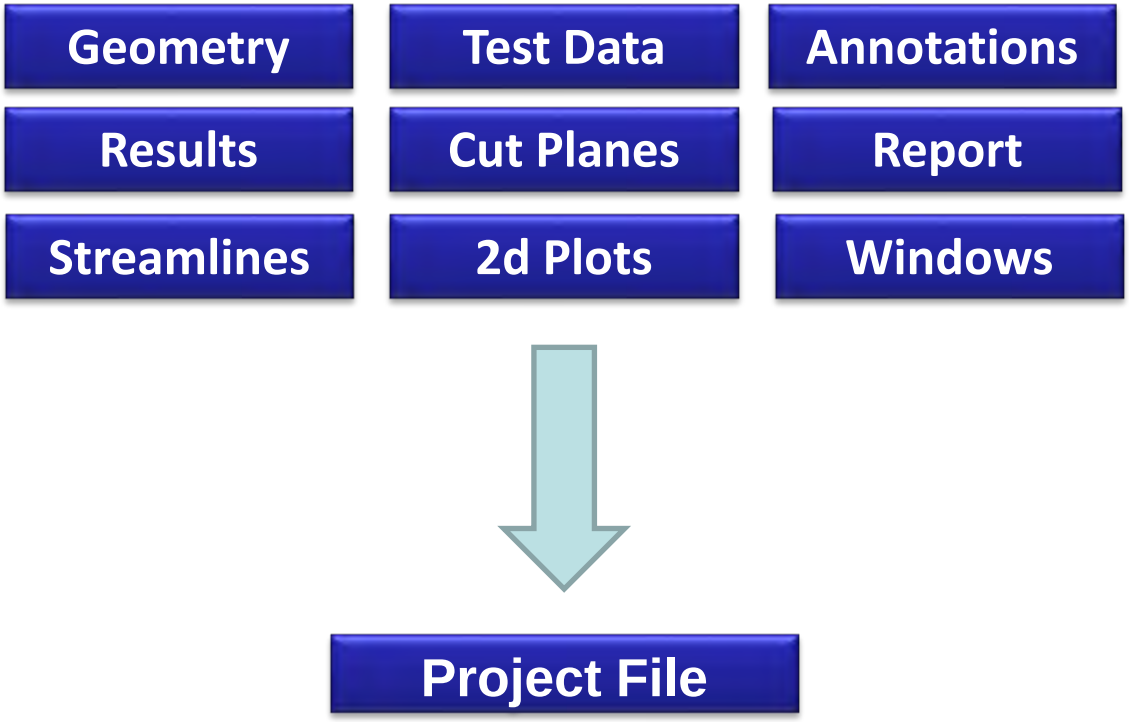






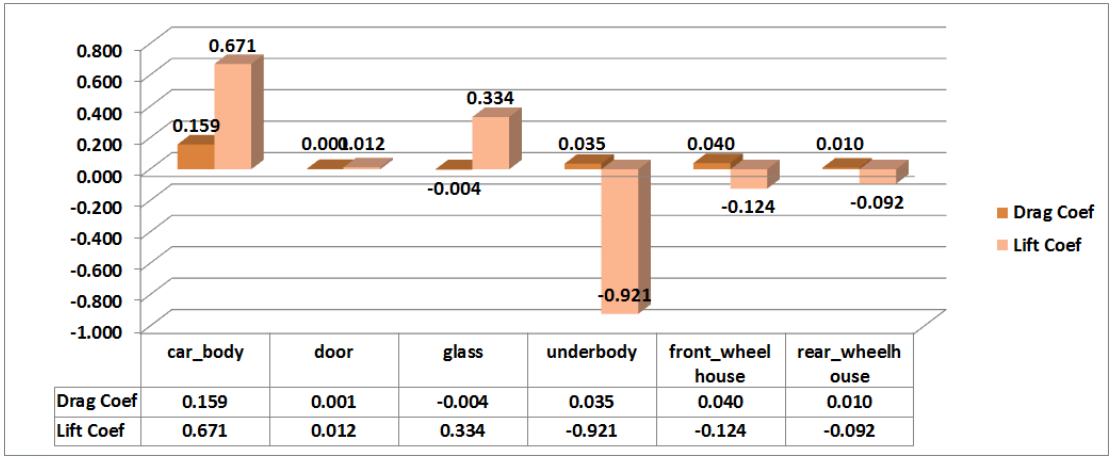
Project Files

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



µETA native binary format file

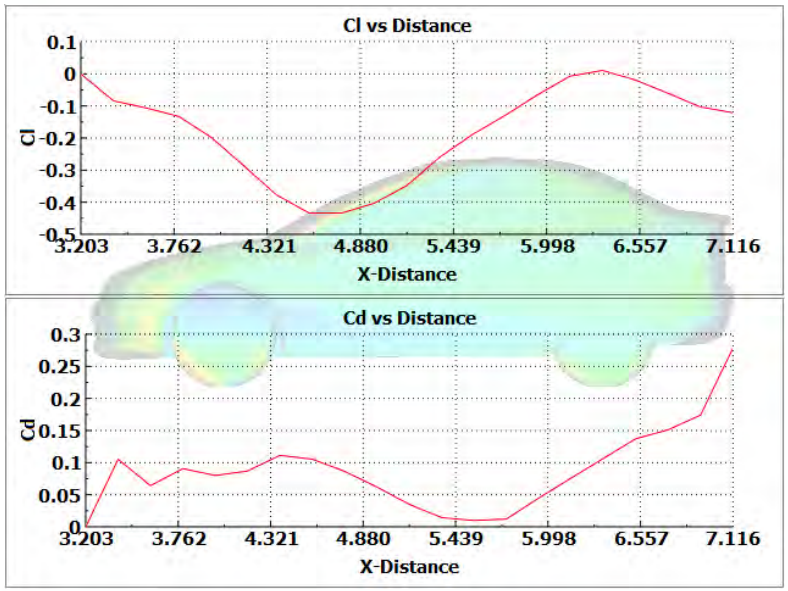
Summary report

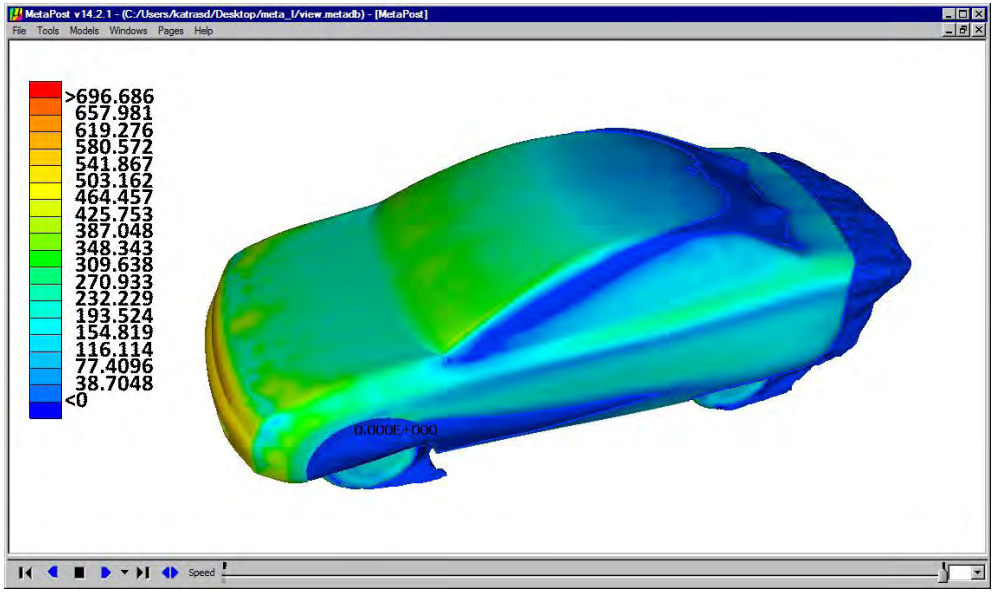


	car_body	door	glass	underbody	front_wheel house	rear_wheelh ouse
Drag Coef	0.159	0.001	-0.004	0.035	0.040	0.010
Lift Coef	0.671	0.012	0.334	-0.921	-0.124	-0.092

Forces-Coefs

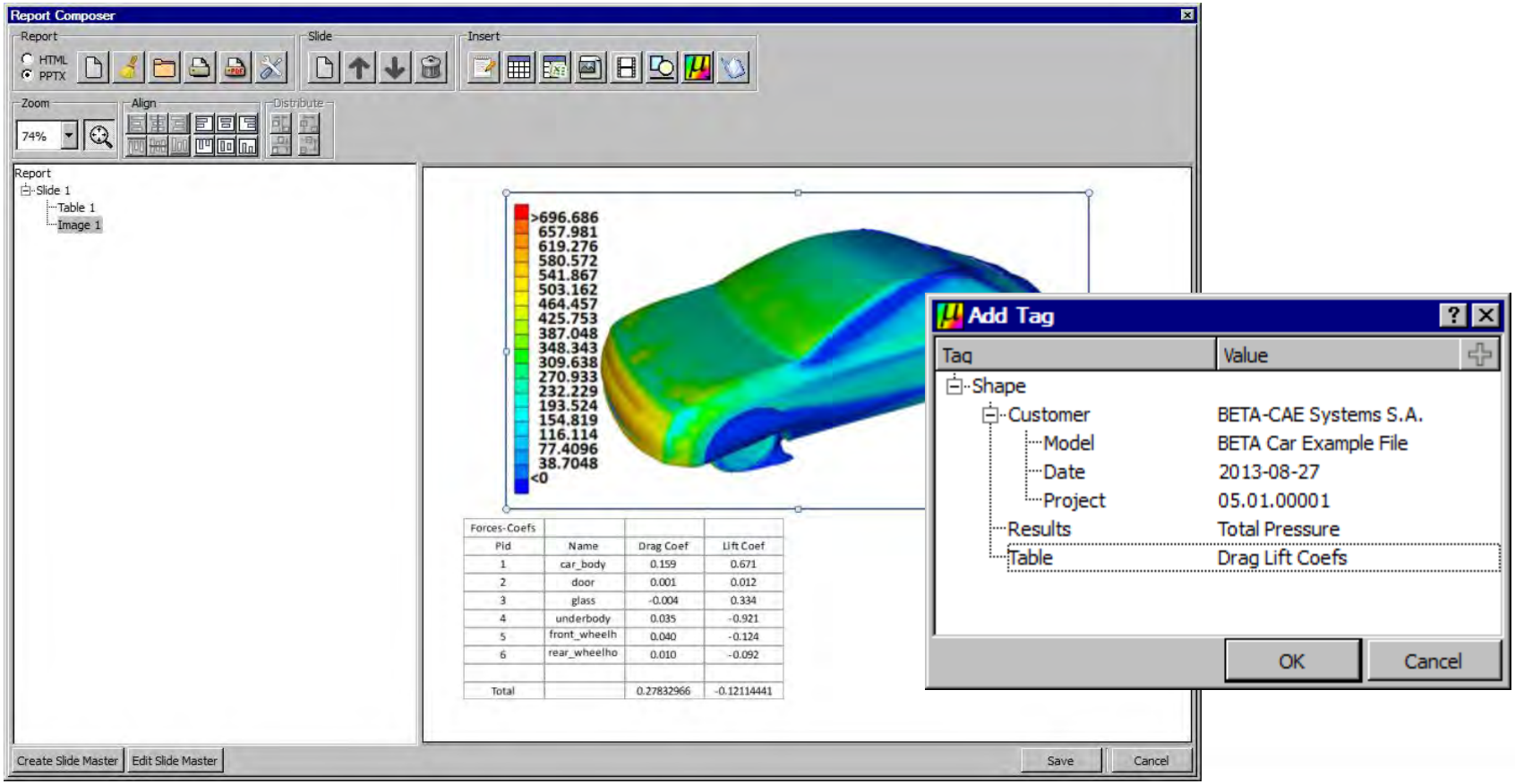
Pid	Name	Drag Coef	Lift Coef
1	car_body	0.159	0.671
2	door	0.001	0.012
3	glass	-0.004	0.334
4	underbody	0.035	-0.921
5	front_wheelhouse	0.040	-0.124
6	rear_wheelhouse	0.010	-0.092
Total		0.27832966	-0.12114441





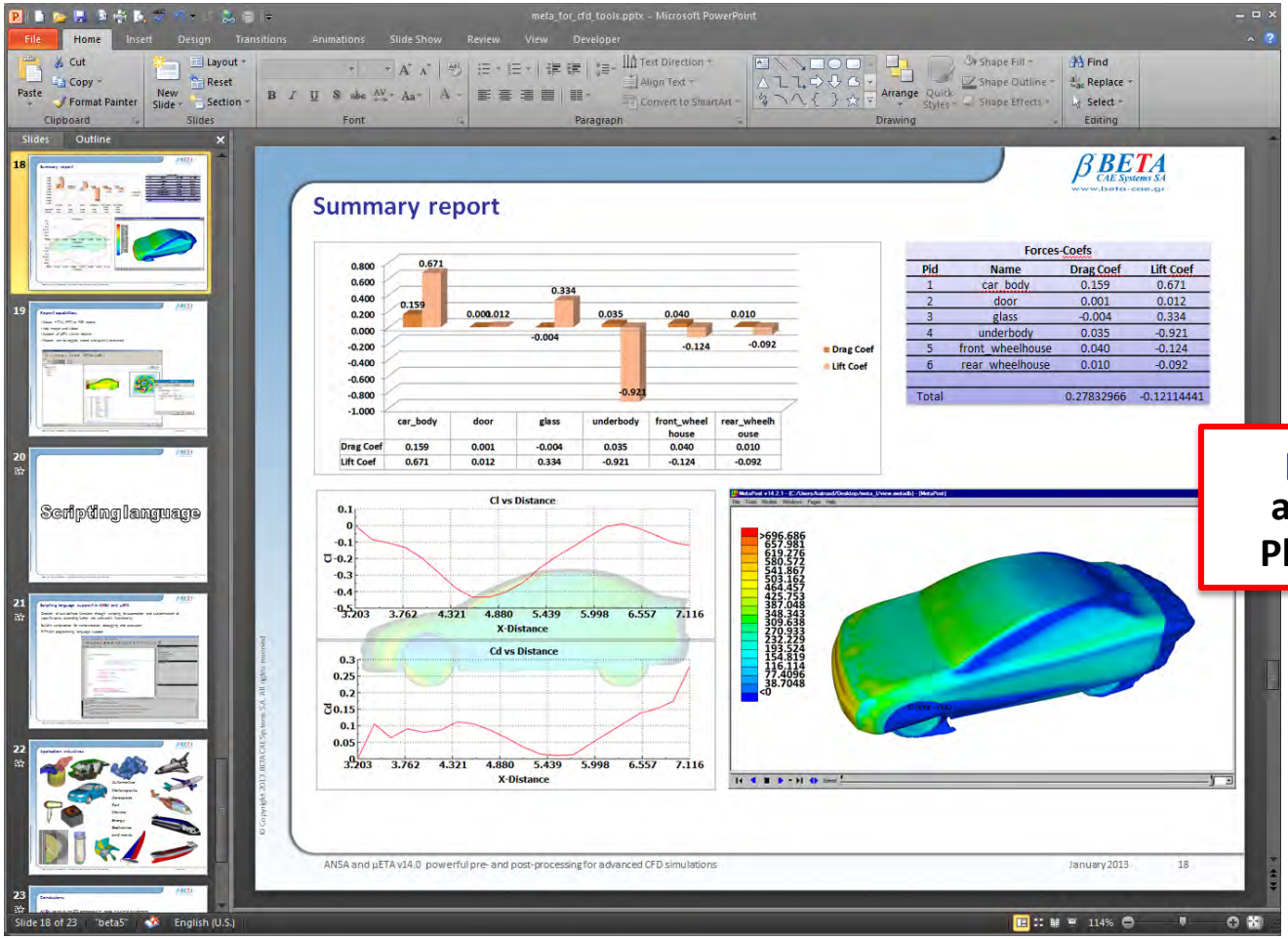
Report capabilities

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



µETA Viewer

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



µETA Viewer as PowerPoint Plug-in in Slides

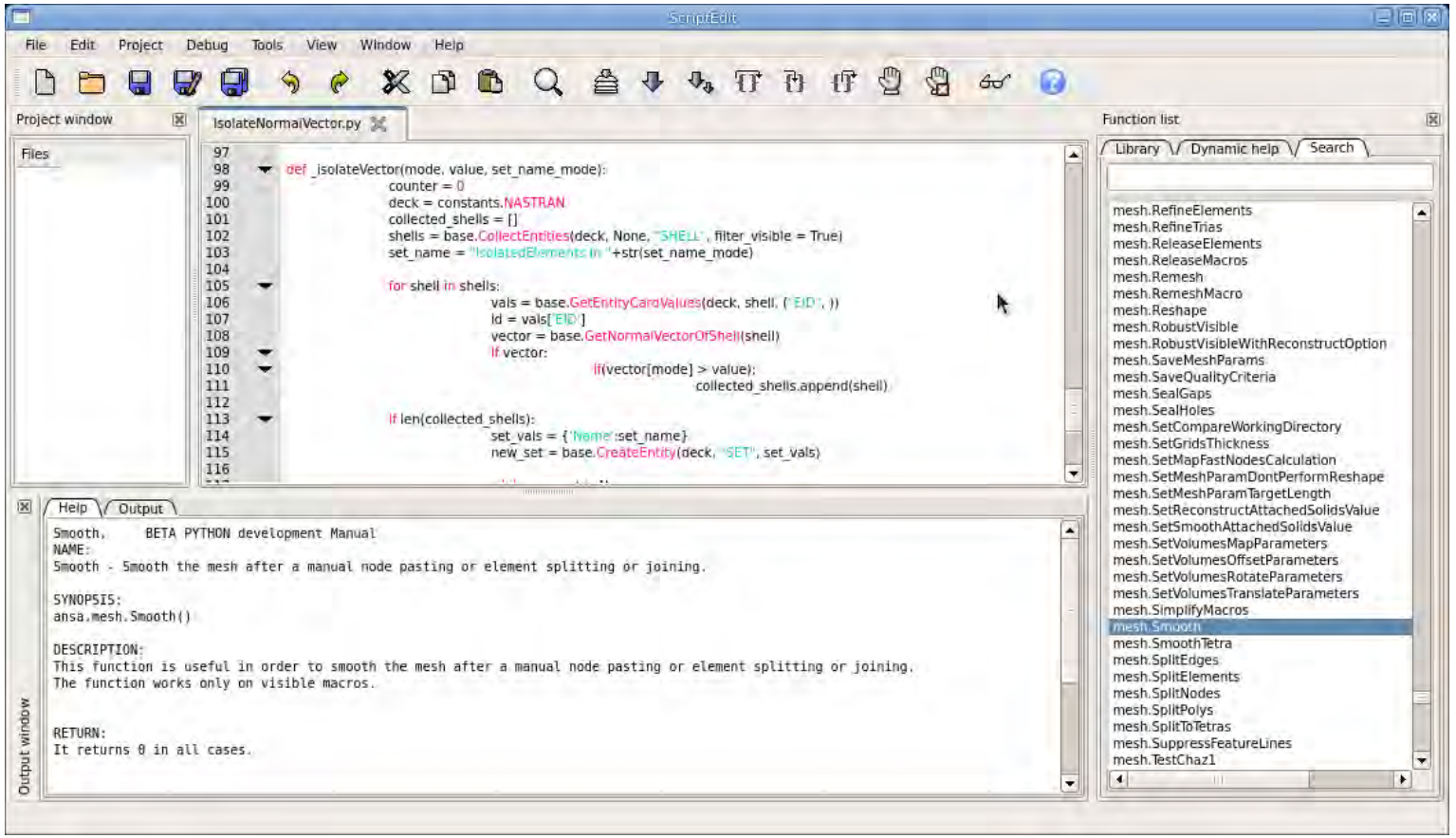
Scripting language

Scripting language support in ANSA and µETA

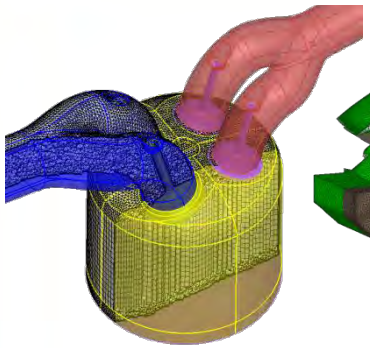
Creation of user defined functions through scripting for automation and customization of specific tasks, extending further the software's functionality

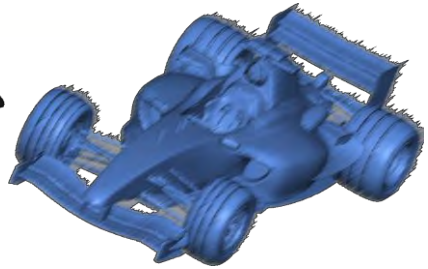
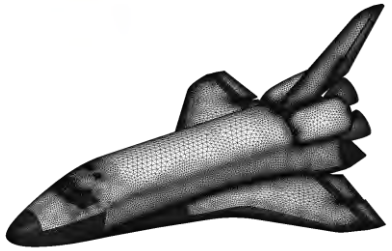
Build-in script editor for script creation, debugging and execution

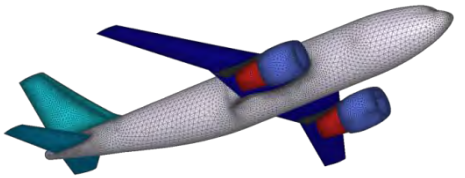
PYTHON programming language support

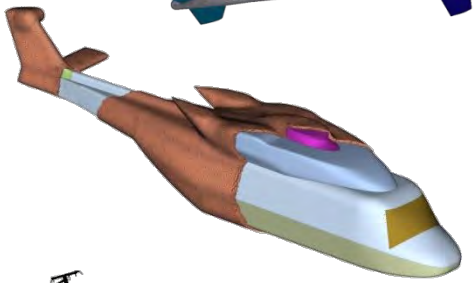


Application industries





Automotive

Motorsports

Aerospace

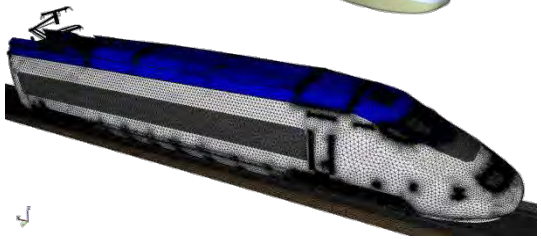
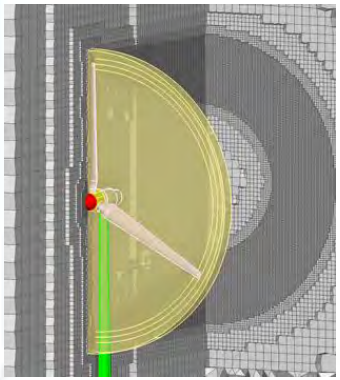
Rail

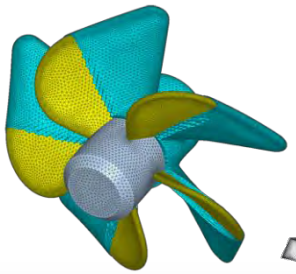
Marine

Energy

Electronics

and more..



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.

µETA 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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URL: http://www.beta-cae.gr