

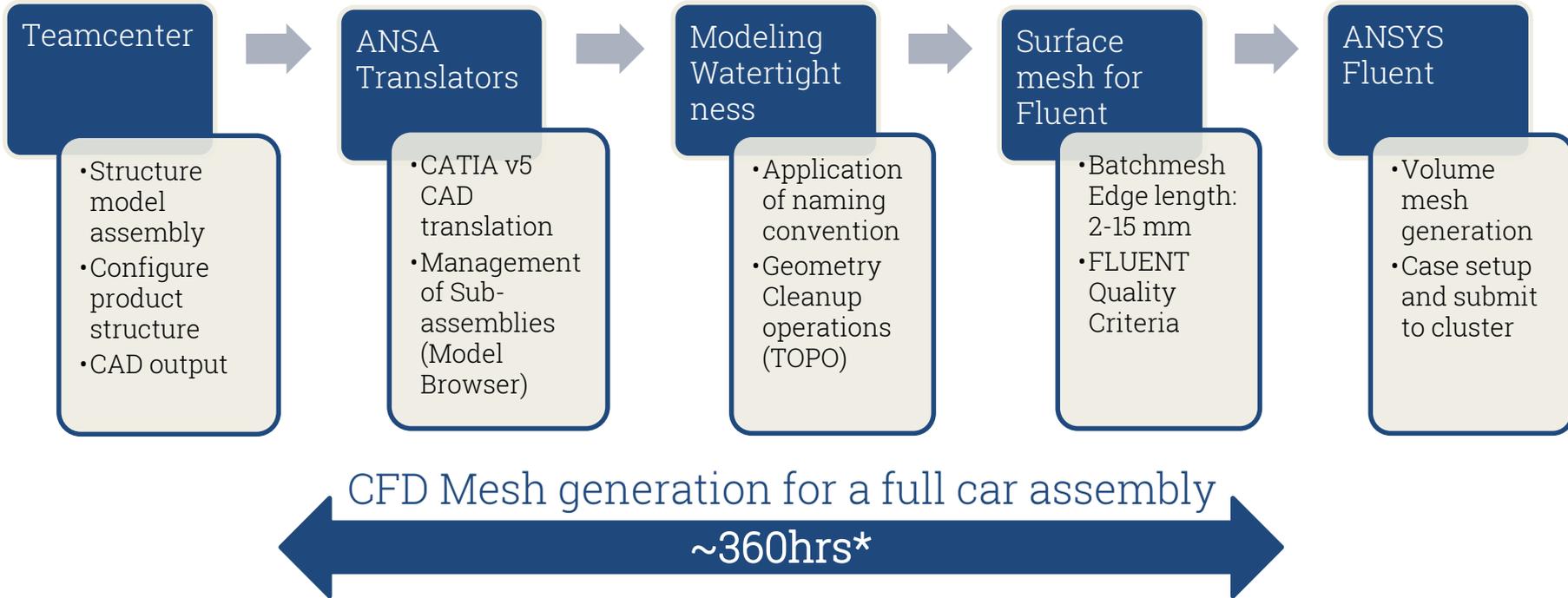
# Efficient watertight preparation tools & methods for CFD meshing at Groupe PSA



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BETA CAE Systems SA

Gaël Roy  
Groupe PSA

# CFD model preparation cycle at Groupe PSA



\*modeling work performed by Tech Center Morocco



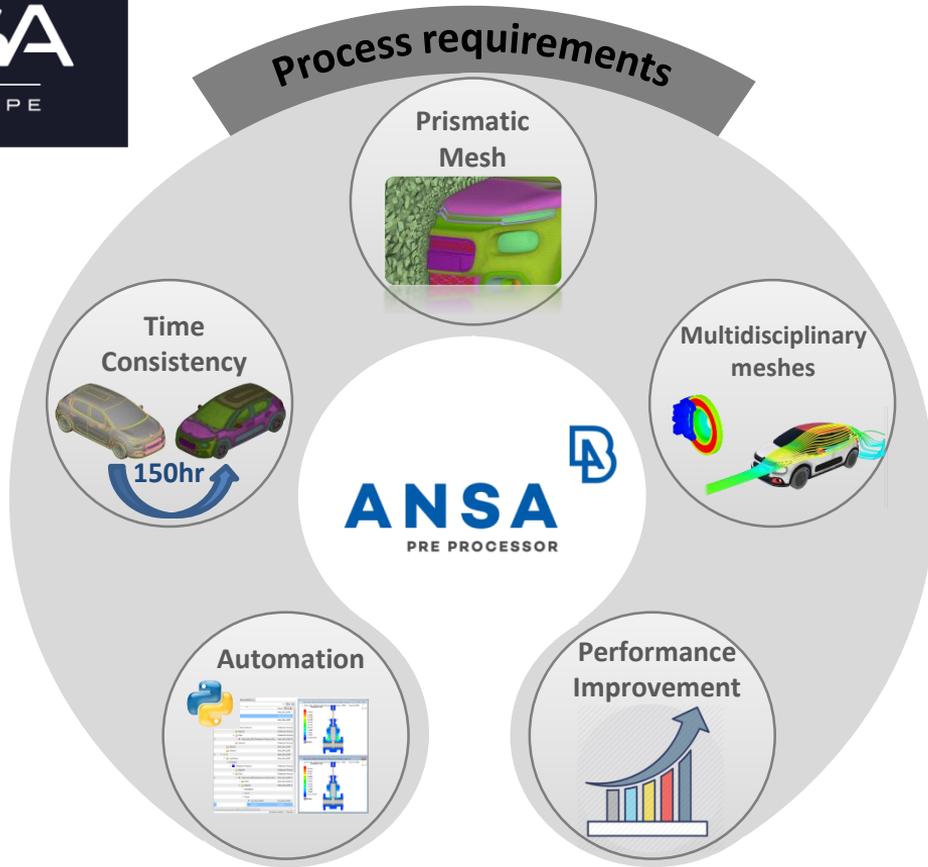
# Watertight preparation challenges

## Watertight Preparation Challenges

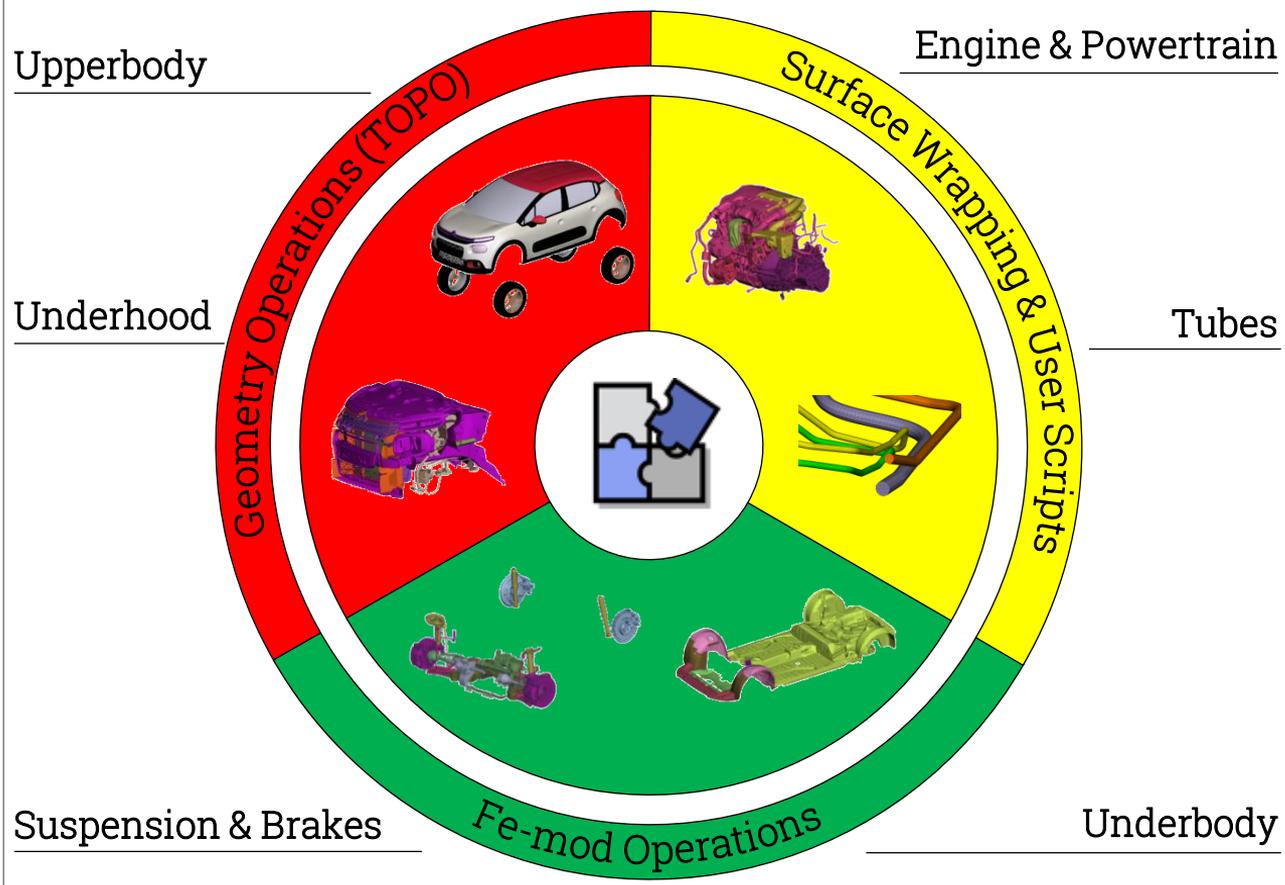
- Incorrect translation data
- Poor CAD description – TOPO errors
- De-features of complex parts
- Isolate exterior surfaces
- Low automation level
- Other...



**360hr**  
Reduce CFD mesh generation turnaround times



Modeling process requirements



# Assembly Management in Model Browser

- High aerodynamic importance
- Average aerodynamic importance
- Low aerodynamic importance

# Reduce workload by deleting symmetry parts

1. Separate model in sub assemblies

2. Delete unnecessary and symmetrical components

3. Watertight per assembly and symmetry copy back

4. Merge and connect all assemblies



# Identify Similar components

Legend:

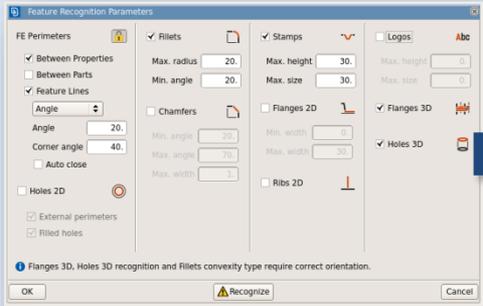
- Red: Source parts
- Green: Target parts
- Blue: Unmatched

Isolate>Similar Groups  
– Key features

- ✓ Automatic identification of similar components
- ✓ Preview of matching groups
- ✓ User defined Similarity tolerance

# De-features complex parts

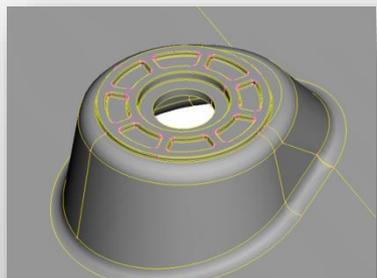
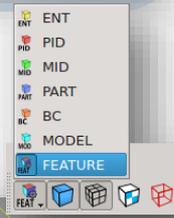
## Feature Manager – Key features



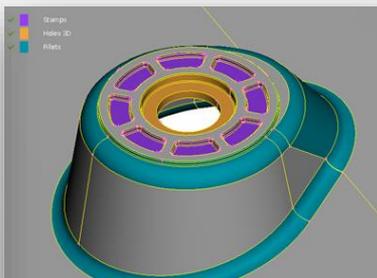
ID	Convexity	Min. Radius	Max. Radius	Min. Width	Max. Width	Min. Angle	Max. Angle
867	Convex	0.5	0.5	0.31	0.97	35.65	111.05
868	Concave	10.	14.02	14.94	15.71	89.98	90.
869	Concave	8.	8.	6.41	7.71	45.89	55.19
870	Concave	2.5	2.5	1.87	2.06	42.77	47.31
871	Concave	8.	9.65	5.78	8.41	59.18	60.43
872	Concave	2.5	2.5	1.05	3.71	24.17	85.02
873	Concave	8.	9.59	5.78	8.4	59.27	60.43
874	Concave	2.5	2.5	2.62	3.71	60.	85.02
875	Concave	8.	12.39	5.79	9.44	59.34	60.43
876	Convex	1.	1.	0.42	1.7	24.17	87.22
877	Concave	5.	11.2	7.82	9.39	89.56	91.28
878	Concave	5.	7.05	5.93	7.39	84.45	85.36
879	Concave	5.	11.13	6.86	8.24	78.64	80.
880	Concave	8.	16.8	7.68	8.7	54.58	55.
881	Concave	3.33	4.8	2.85	4.94	46.67	80.9
882	Concave	8.	8.	2.42	7.69	17.31	55.04
883	Concave	8.	8.	7.69	7.69	55.09	55.1
884	Convex	0.5	0.5	0.58	1.23	66.22	141.07
885	Concave	2.5	2.5	2.63	2.97	60.33	68.14

- ✓ Automatic tool for identification of features (2D/3D holes, fillets, stamps etc)
- ✓ Customized Mesh treatment

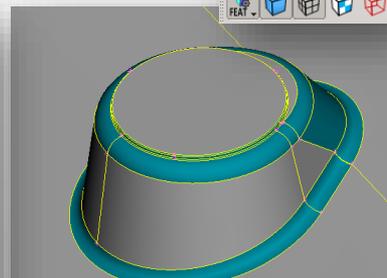
- ✓ Stamps
- ✓ Flanges 3D
- ✓ Holes 3D
- ✓ Fillets



No identified features



Highlighted features



Design Action>Remove



Upperbody

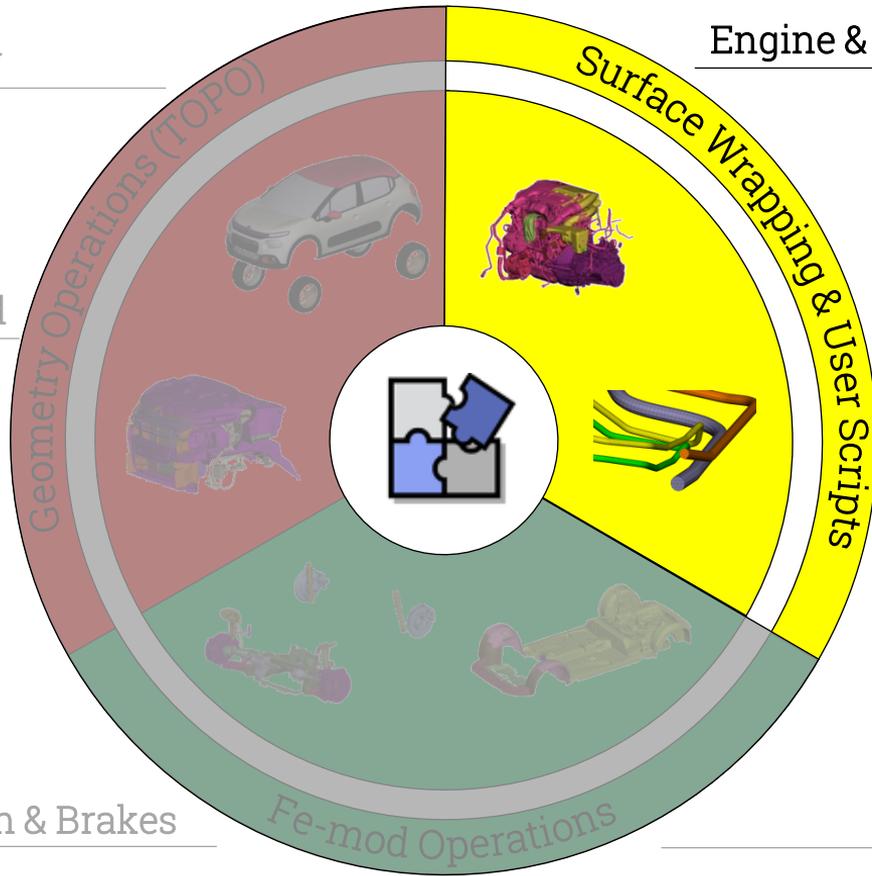
Underhood

Suspension & Brakes

Engine & Powertrain

Tubes

Underbody



# Assembly Management in Model Browser

- High aerodynamic importance
- Average aerodynamic importance
- Low aerodynamic importance

# Challenges in PreWrapping process

Merge PID of Similar  
Components

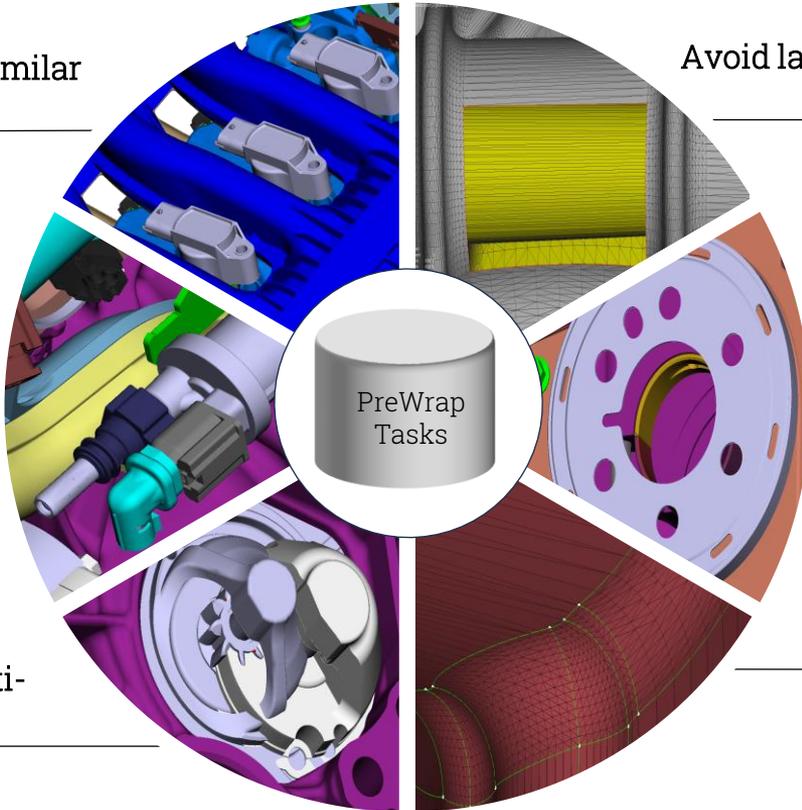
Avoid large unmeshed  
macros

Delete Small  
Components

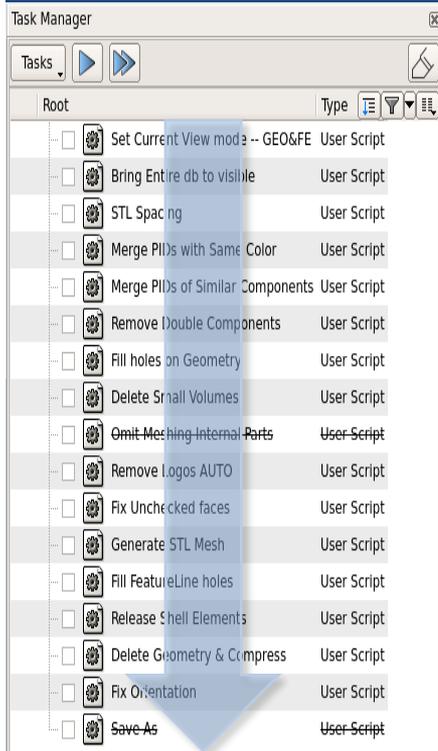
Closing Holes

Removing Multi-  
instances

STL meshing

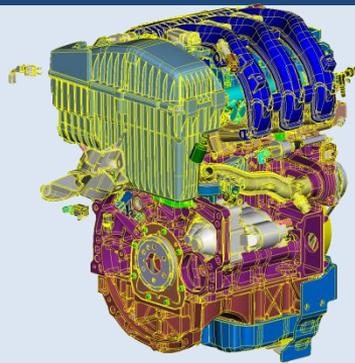


# ANSA Task Manager - PreWrap Template



PID's: 3100  
Conn Groups: 5765  
Faces: 3mil

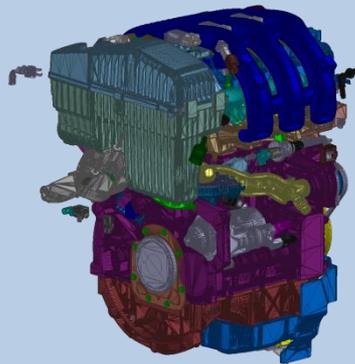
Size: 2.5GB



Geometry

PID's: 190  
Conn Groups: 645  
Shells: 7mil

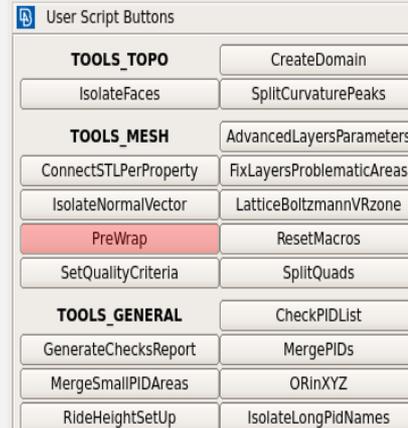
Size: 350MB



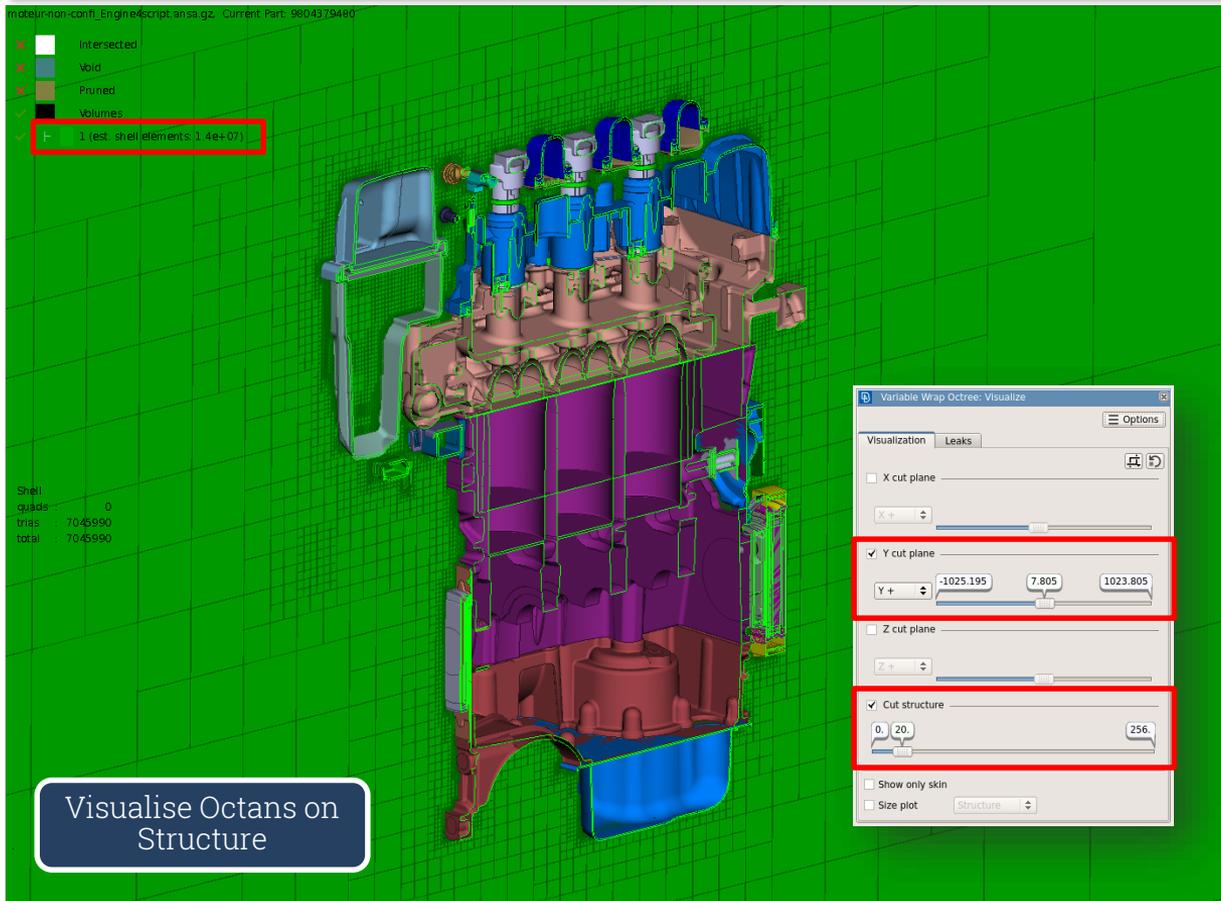
FE-mod

## Automation for Prewrapping process

### CFD Script Buttons



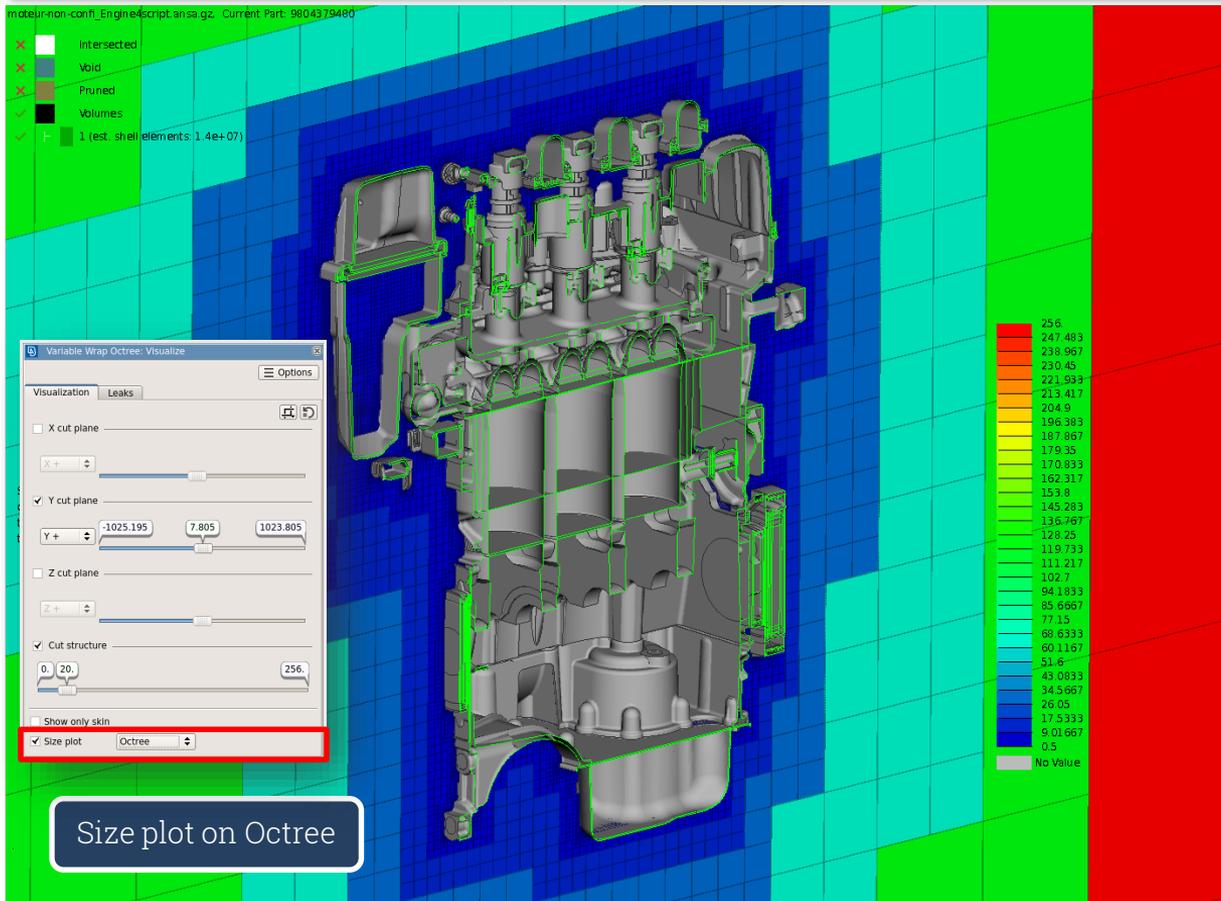
# Visualization of Octree entity



All new Octree algorithm

- ✓ Visualization of Octree along Structure assembly
- ✓ Easy-to-handle cut planes on both Octree and Structure
- ✓ Estimation of total shell elements during Visualize stage

# Size plot on Octree entity



All new Octree algorithm

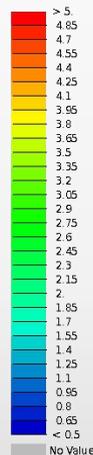
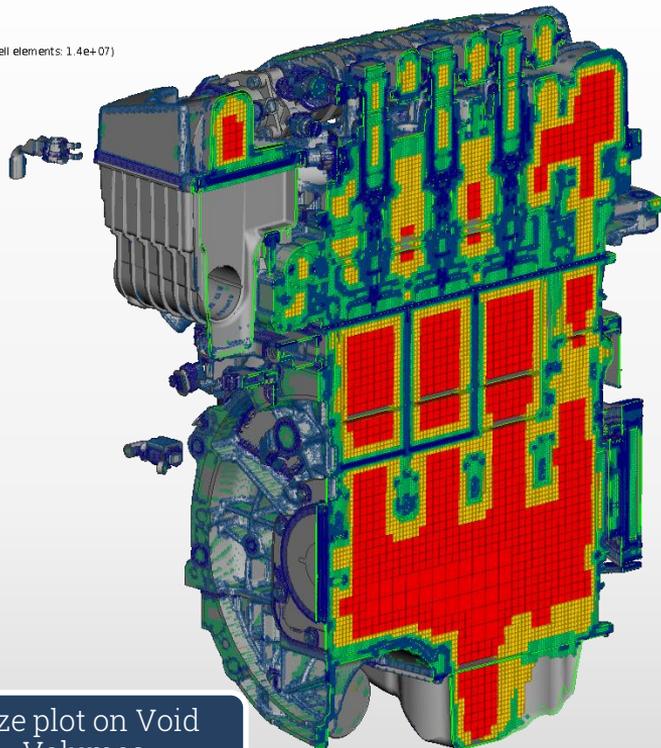
✓ Preview of size length on the Octree

Size plot on Octree

# Identification of Void Volumes

motor-non-conf\_Engine4script.ansa.gz. Current Part: 9804379480

- ✗ Intersected
- ✓ Void
- ✗ Pruned
- ✗ Volumes
- ✗ 1 (est. shell elements: 1.4e+07)



All new Octree algorithm

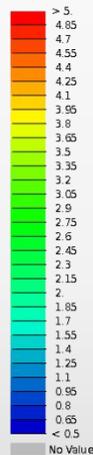
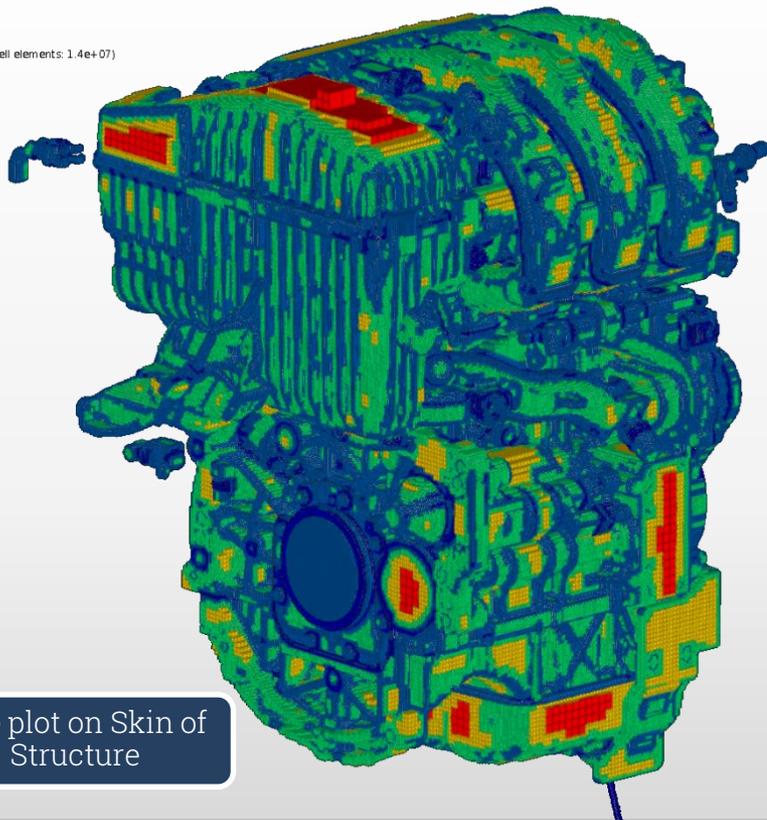
- ✓ Easy identification of Void volumes (no Octree intrusion)

Size plot on Void Volumes

# Highlight high resolutions areas

moteur-non-conh\_Engine4script.ansa.gz. Current Part: 9604379480

- ✗ Intersected
- ✗ Void
- ✗ Pruned
- ✓ Volumes
- ✓ 1 (est. shell elements: 1.4e+07)



Size plot on Skin of Structure

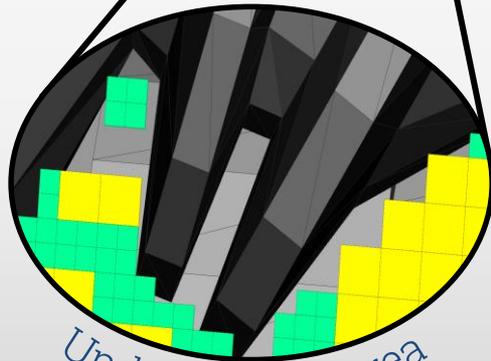
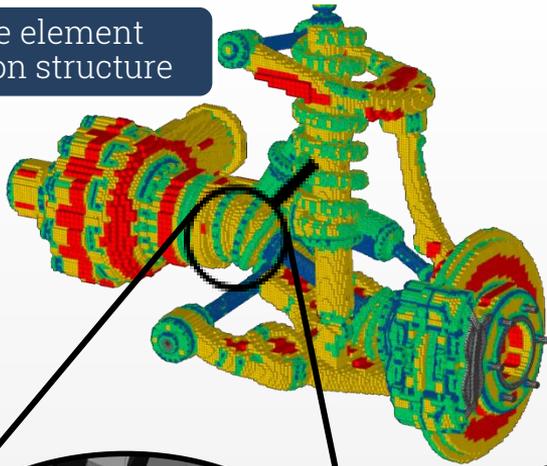
All new Octree algorithm

- ✓ Easy identification of refinement zones across proximities

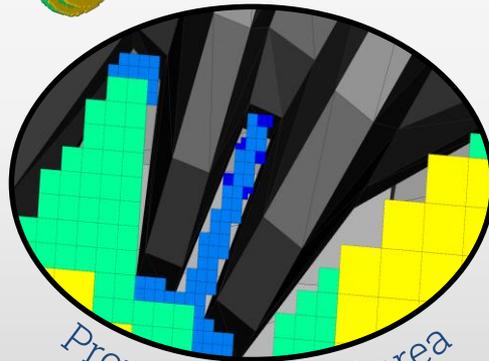
# Identification of under-refined areas

All new Octree algorithm

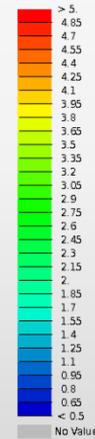
Octree element length on structure



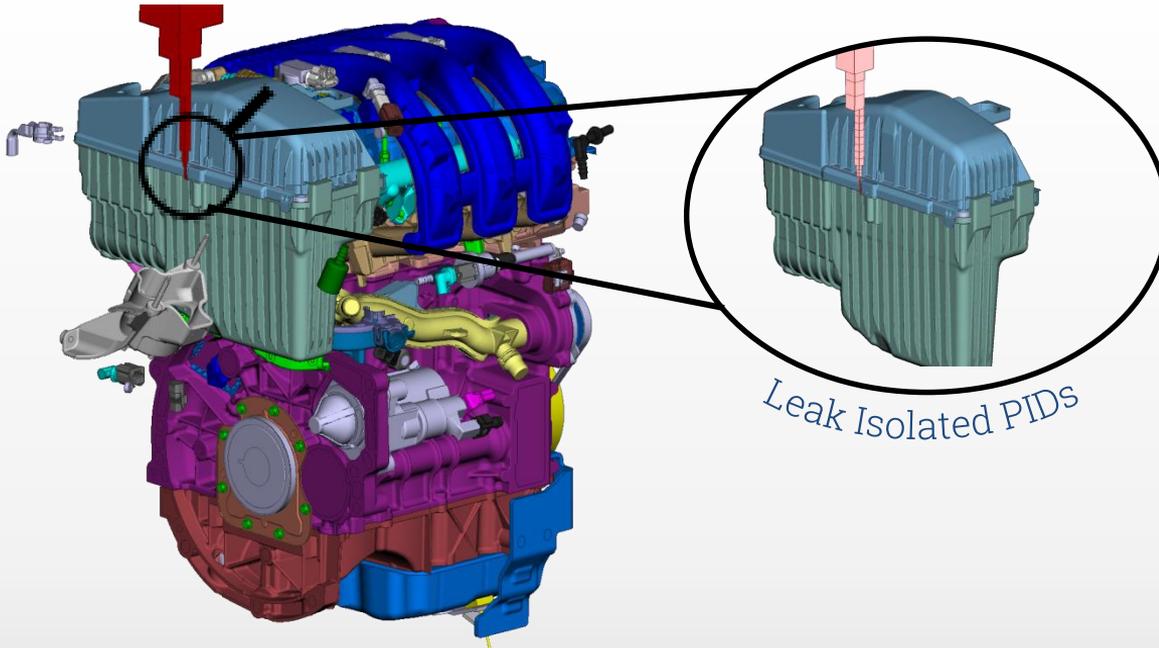
Under-refined area



Properly-refined area



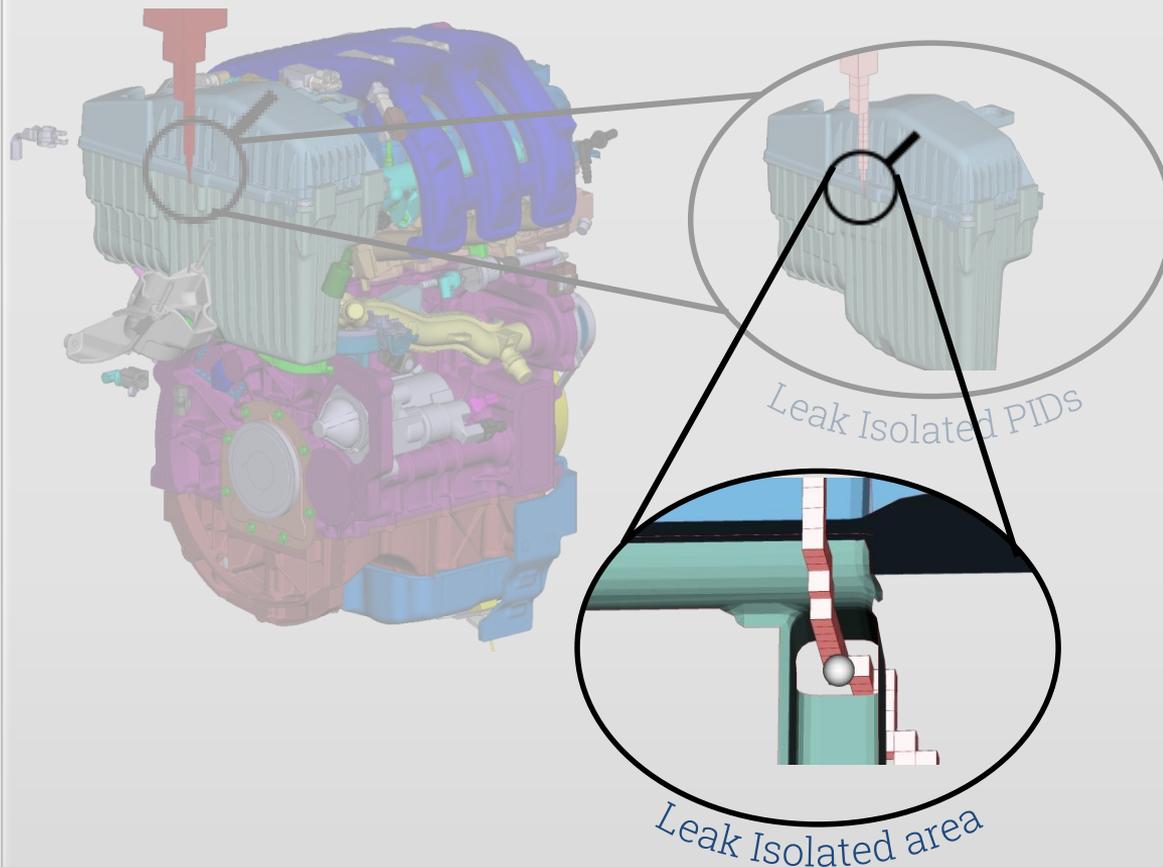
## Leak detection



All new Octree algorithm

- ✓ Isolation of leaked properties/areas

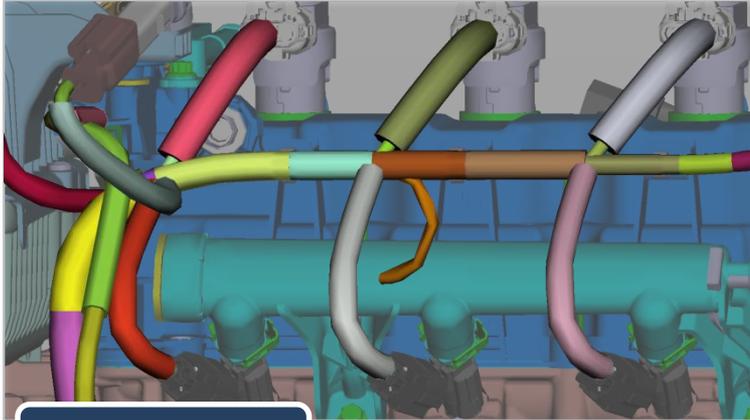
## Leak detection



All new Octree algorithm

- ✓ Isolation of leaked properties/areas

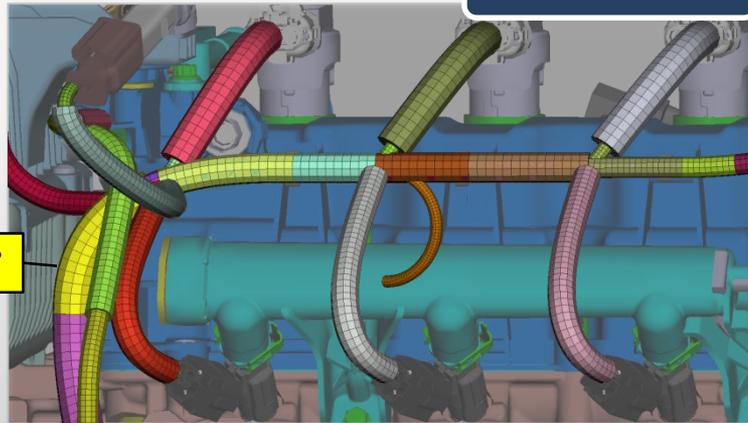
## Tubes & Wires Mesh Generator



Tubes-Geometry



Tubes-Fe-mod



Distortion: 30°

TubesWires user script  
button

- ✓ Automatic tool for shell mesh generation
- ✓ Available for quad/ortho tria shell type
- ✓ Automatic assignment of element length based on distortion angle

Upperbody

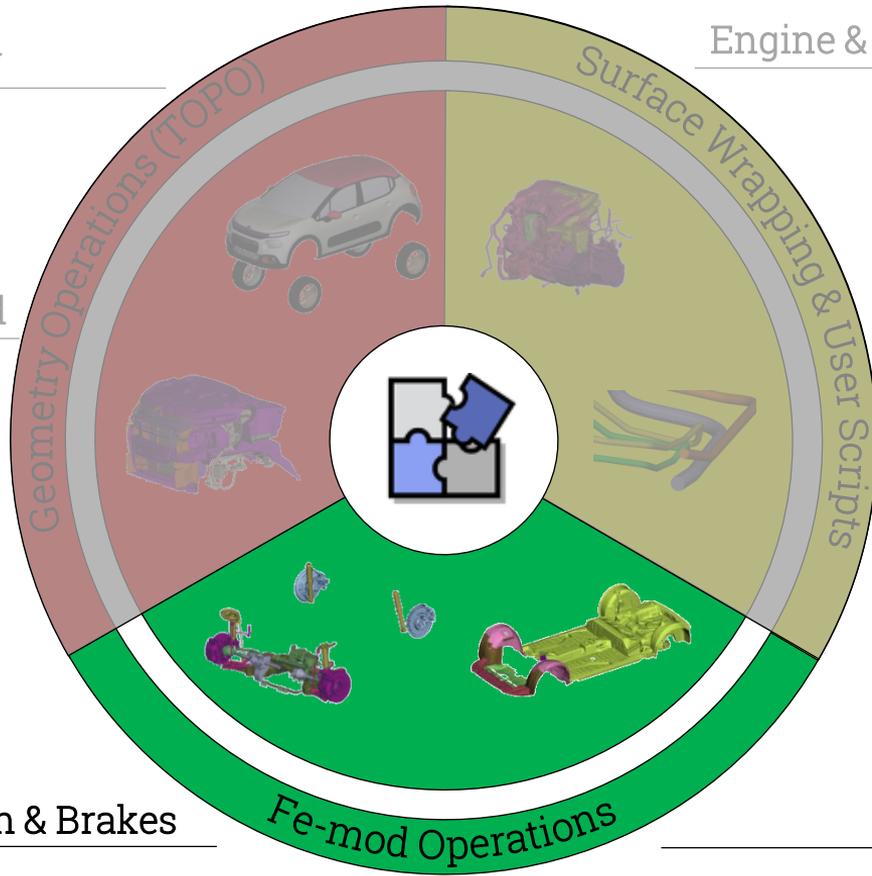
Underhood

Suspension & Brakes

Engine & Powertrain

Tubes

Underbody



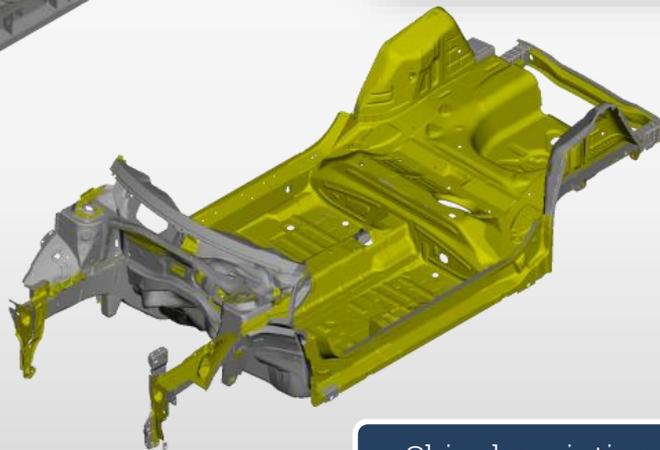
# Assembly Management in Model Browser

- High aerodynamic importance
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- Low aerodynamic importance

## Middle Surface Extraction



Solid description



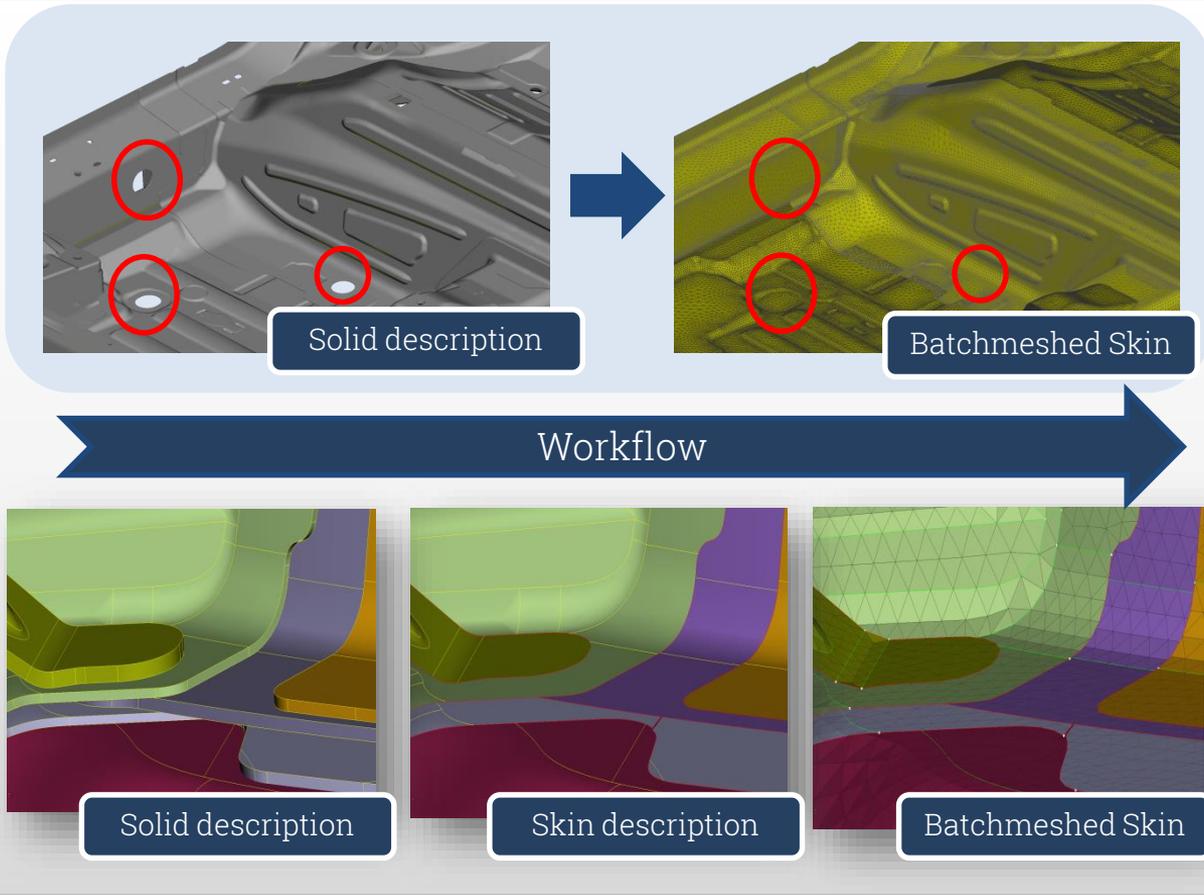
Skin description

Options List	
+ Run Skin on	Visible
- Batch Process	✓
Similarity	Strict
Thick.Deviation	0.05
+ Offset Type	Link
Max.Thickness	6.
Treat Chamfers	✗
Delete Orig. Faces	✓
Skin Part	Use existing
Skin Property	Use existing
+ Apply Thickness	✓
Report failed parts	✓

Mid.Surface>Skin –  
Key features

- ✓ Process acceleration – up to 70% through execution in batch process
- ✓ Generation of report for failed parts (casted, topo problems)

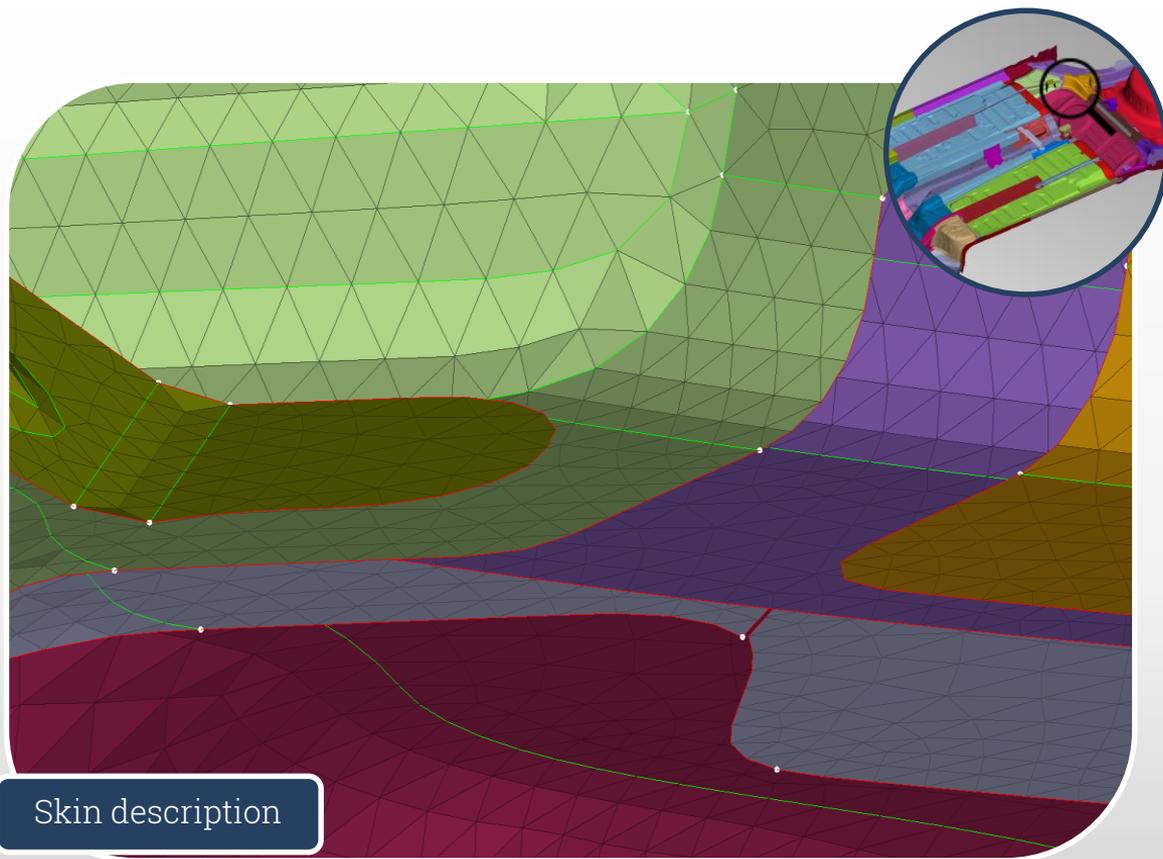
## Methodology steps for intersection at FE-mod



Methodology steps  
before panel  
Connection

1. Extract Mid.Surface from Solid thickness
2. De-featuring of intense features
3. Automatic closure of holes
4. Batchmeshing of panels (Fillet treatment etc)

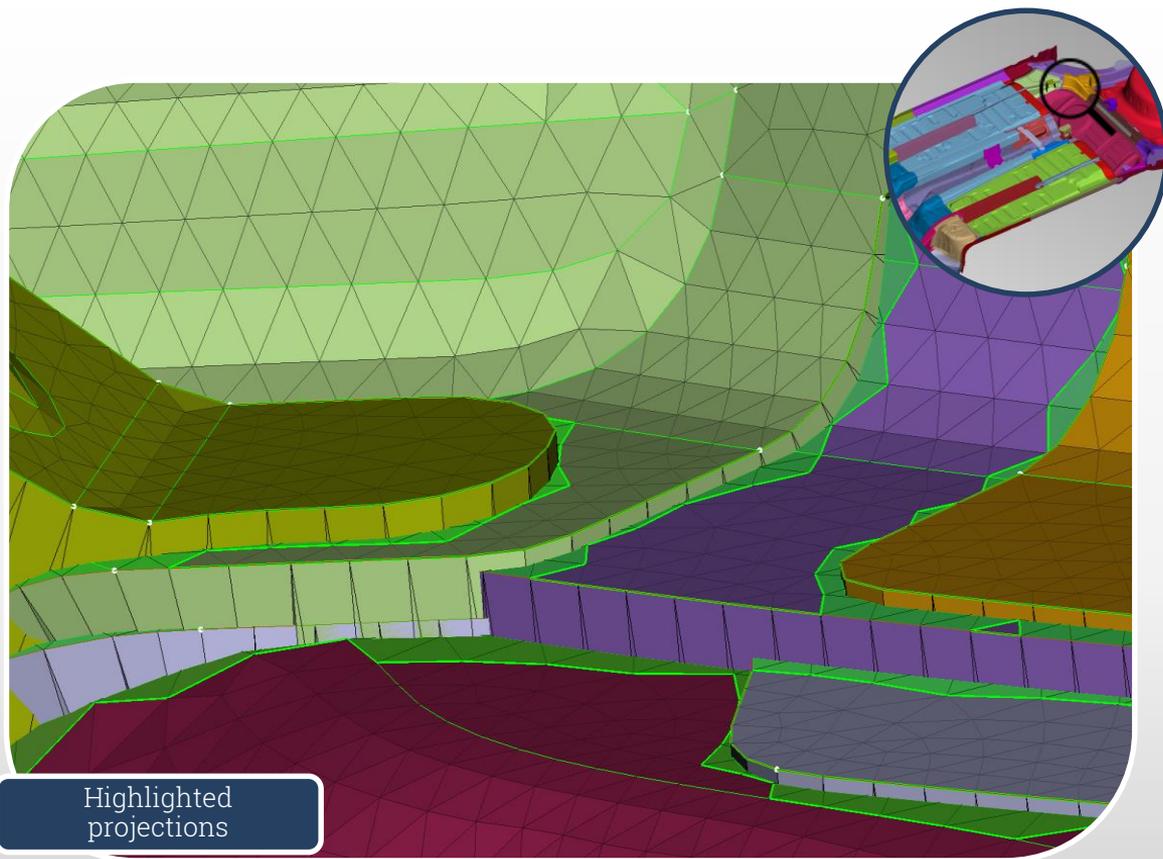
## Fusing gaps of Skin parts – demo case



## Intersect Skin– Key features

- ✓ Automatic tool with acceleration of 90% of watertight closure compared to Geometry operations
- ✓ Preservation of all geometrical features of underlying surfaces

## Fusing gaps of Skin parts – demo case

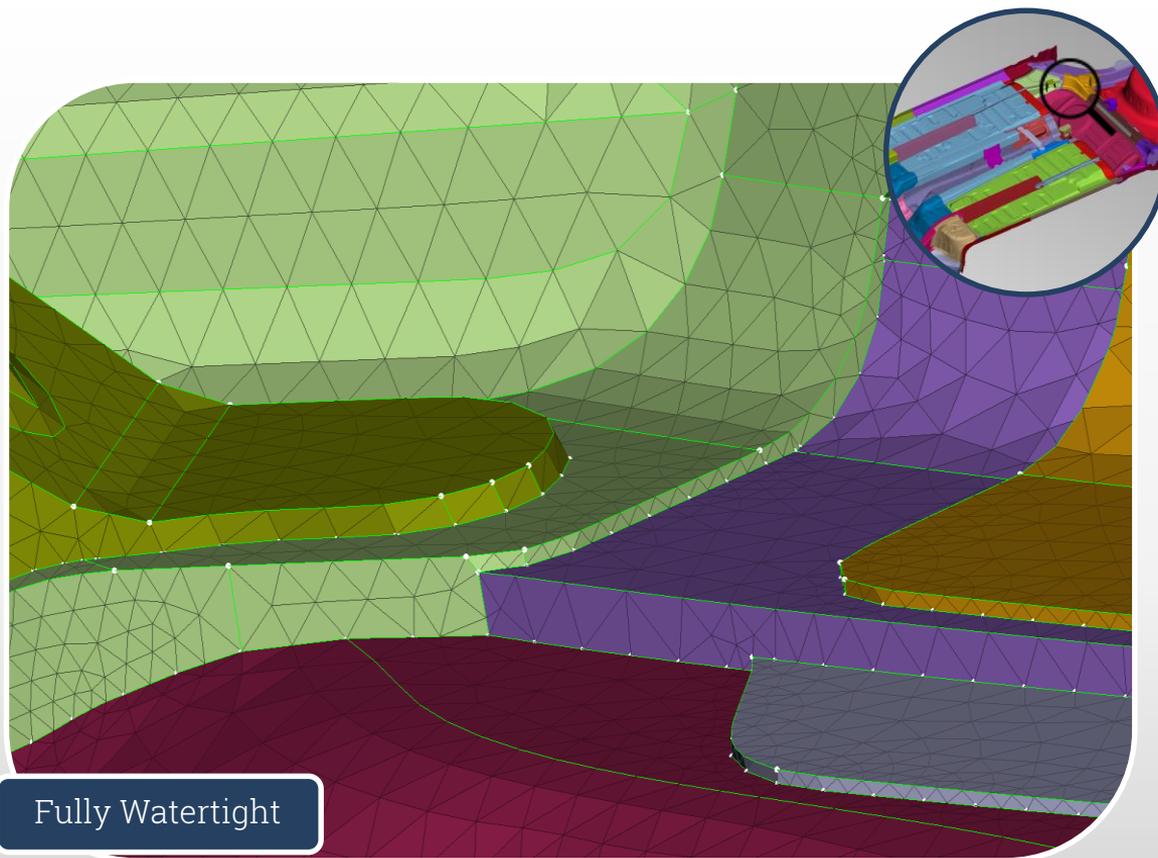


Highlighted  
projections

## Intersect Skin – Key features

- ✓ Automatic tool with acceleration of 90% of watertight closure compared to Geometry operations
- ✓ Preservation of all geometrical features of underlying surfaces

## Fusing gaps of Skin parts – demo case

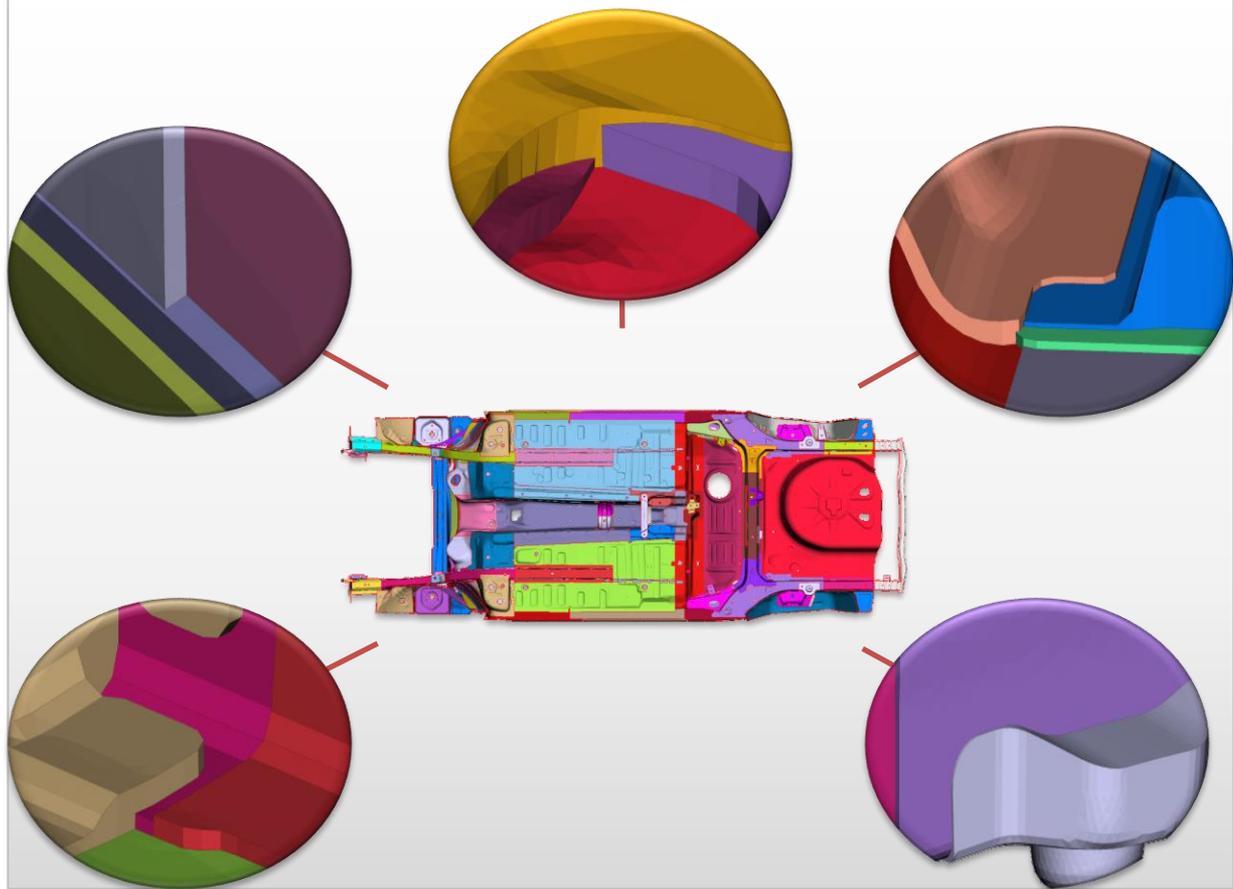


Fully Watertight

## Intersect Skin– Key features

- ✓ Automatic tool with acceleration of 90% of watertight closure compared to Geometry operations
- ✓ Preservation of all geometrical features of underlying surfaces

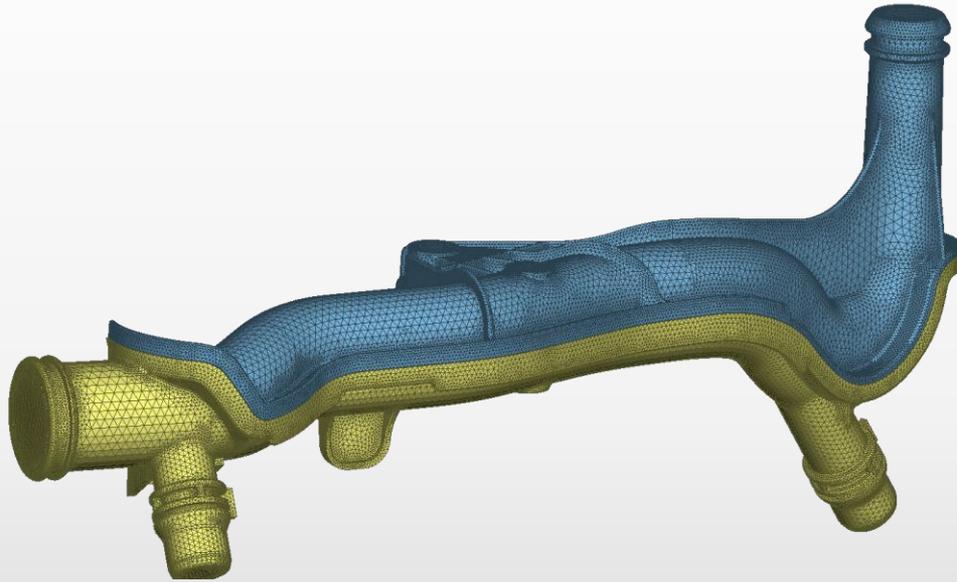
## Fusing gaps of Skin description parts



## Intersect Skin – Key features

- ✓ Automatic tool with acceleration of 90% of watertight closure compared to Geometry operations
- ✓ Preservation of all geometrical features of underlying surfaces

## Fusing gaps of Solid description parts



Solid description

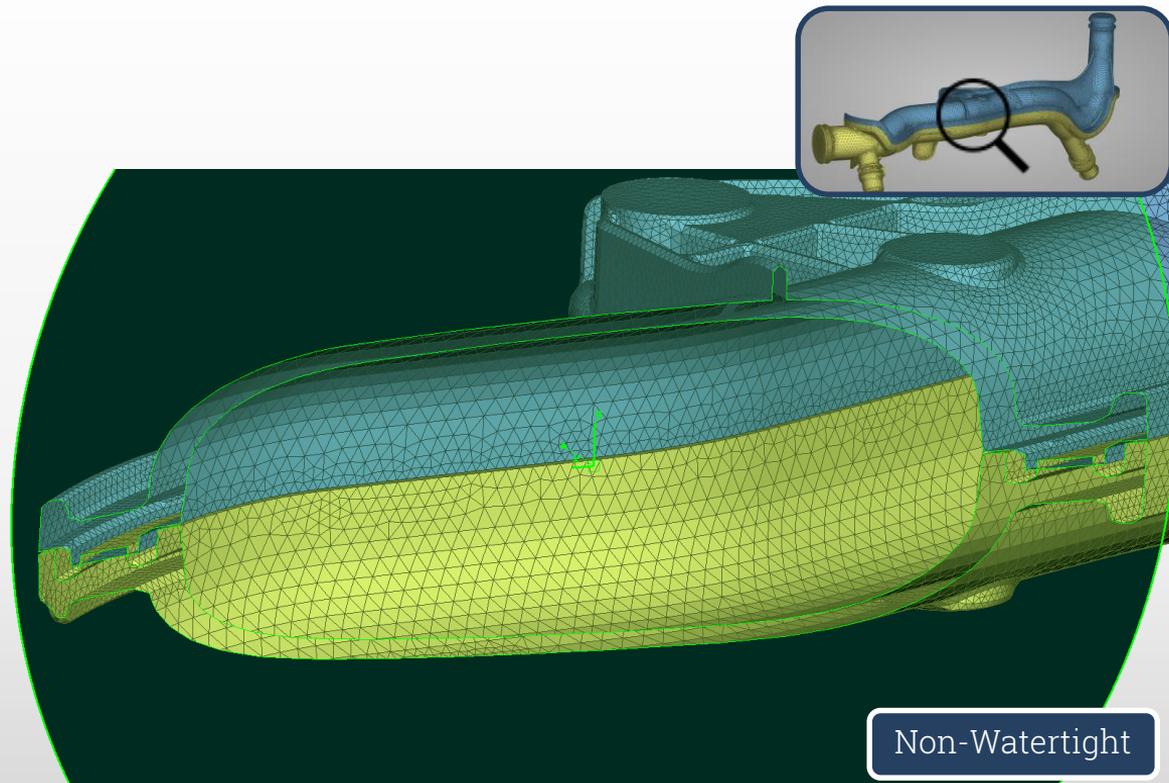
## Intersect Solid– Key features

- ✓ Automatic tool with acceleration of 90% of watertight closure compared to Geometry operations
- ✓ Preservation of all geometrical features of underlying surfaces

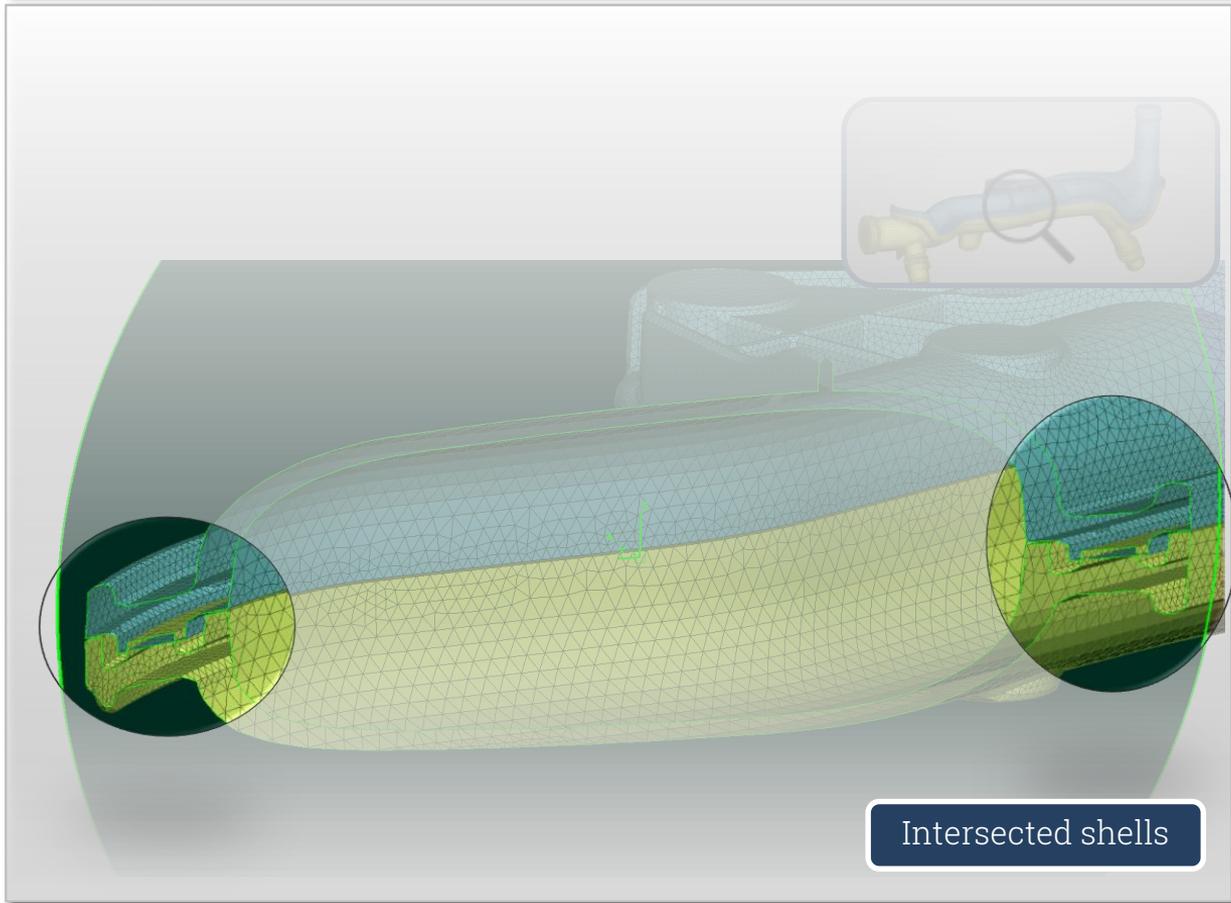
## Fusing gaps of Solid description parts

## Intersect Solid– Key features

- ✓ Automatic tool with acceleration of 90% of watertight closure compared to Geometry operations
- ✓ Preservation of all geometrical features of underlying surfaces



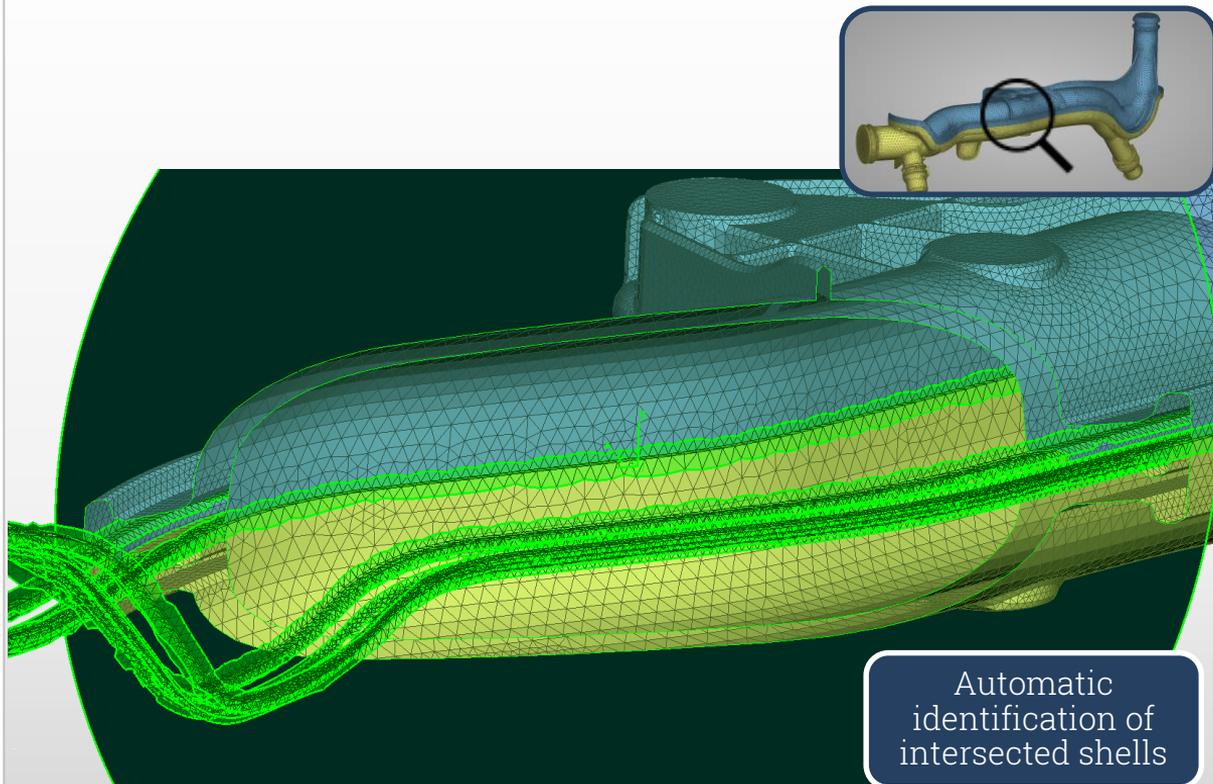
## Fusing gaps of Solid description parts



## Intersect Solid– Key features

- ✓ Automatic tool with acceleration of 90% of watertight closure compared to Geometry operations
- ✓ Preservation of all geometrical features of underlying surfaces

## Fusing gaps of Solid description parts



Automatic  
identification of  
intersected shells

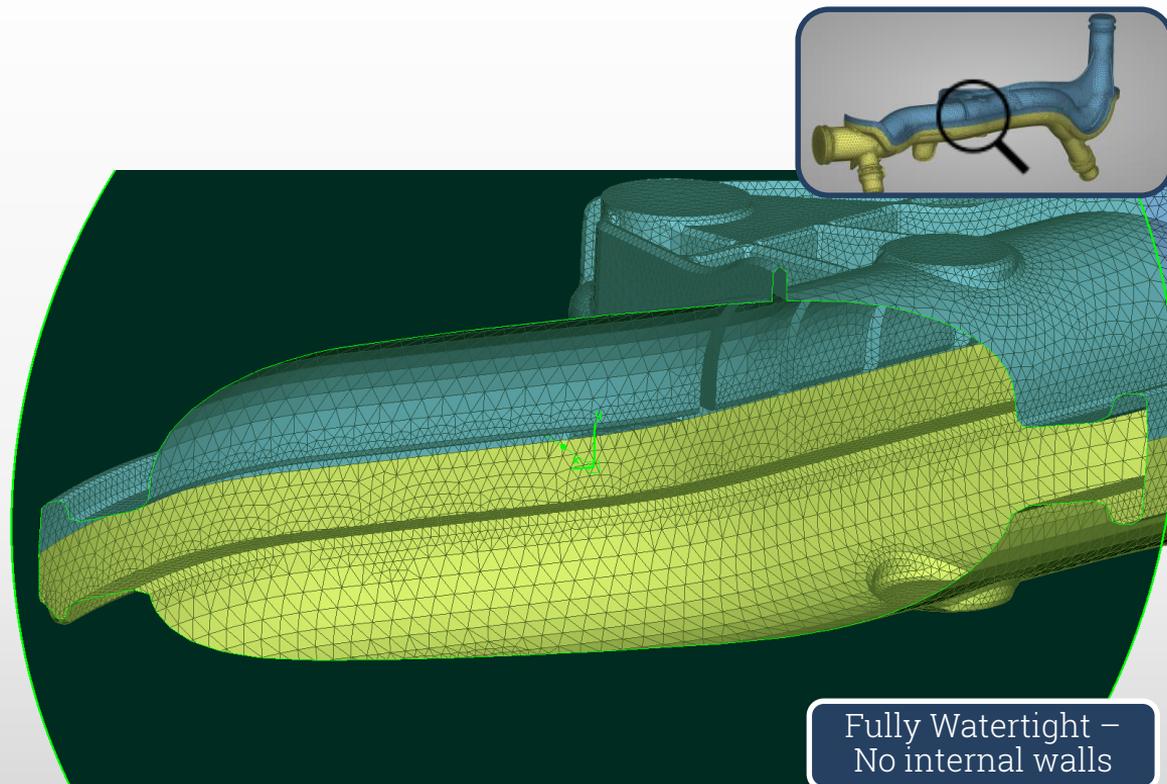
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- ✓ Automatic tool with acceleration of 90% of watertight closure compared to Geometry operations
- ✓ Preservation of all geometrical features of underlying surfaces

## Fusing gaps of Solid description parts

## Intersect Solid – Key features

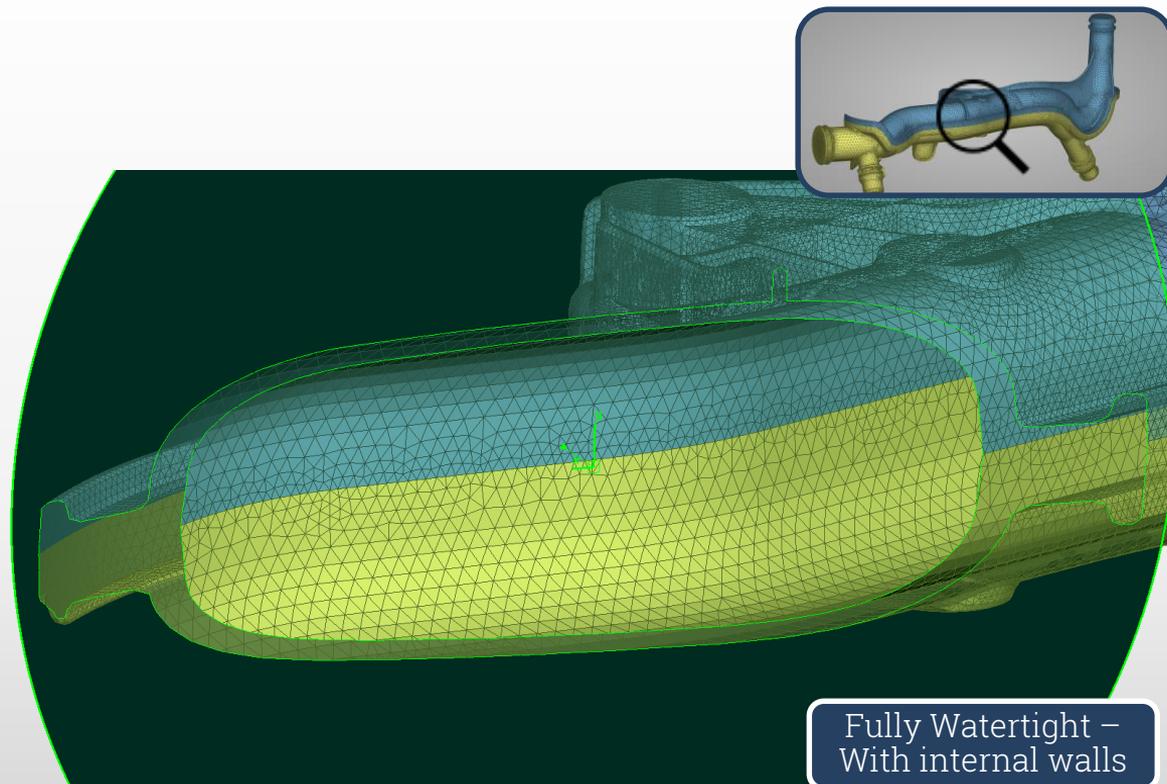
- ✓ Automatic tool with acceleration of 90% of watertight closure compared to Geometry operations
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## Fusing gaps of Solid description parts

## Intersect Solid – Key features

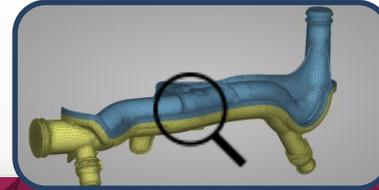
- ✓ Automatic tool with acceleration of 90% of watertight closure compared to Geometry operations
- ✓ Preservation of all geometrical features of underlying surfaces



## Volume meshing of Solid Components

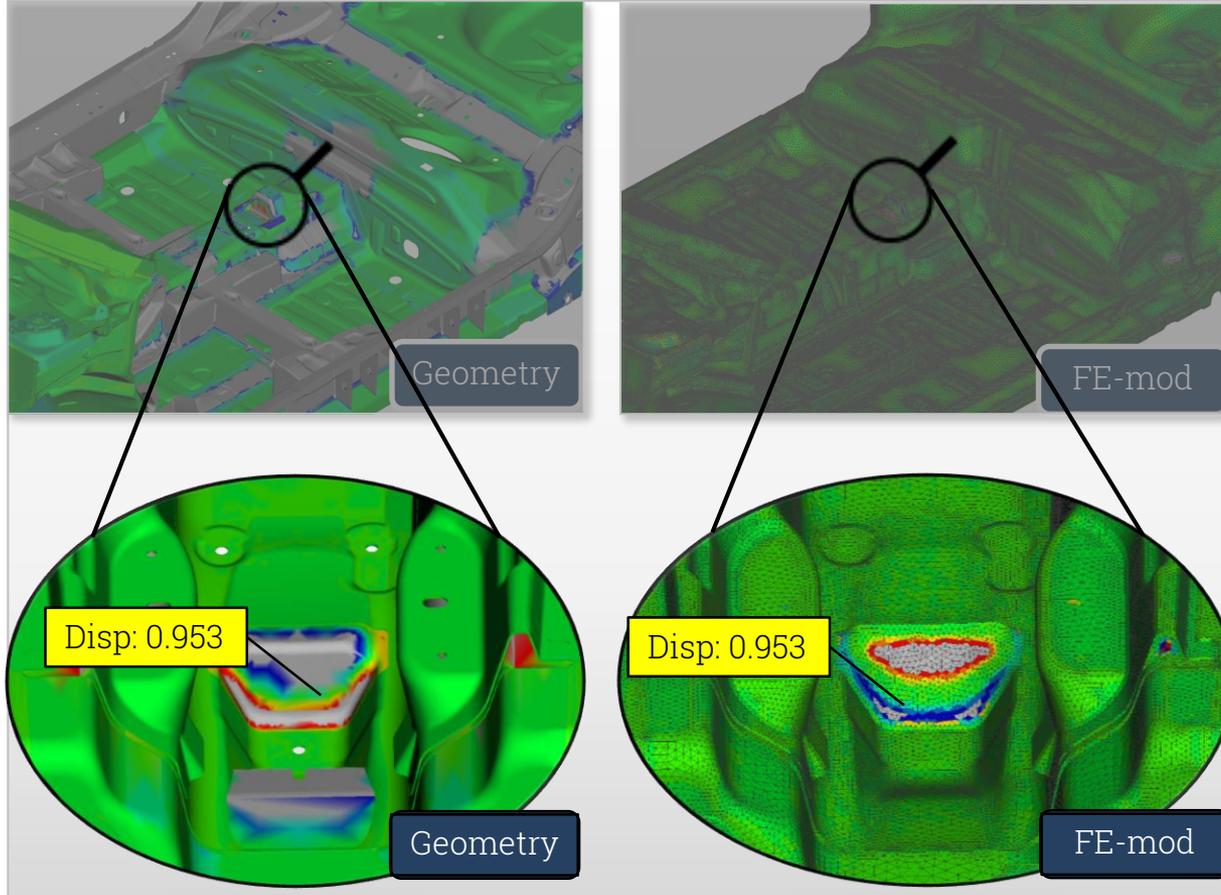
Intersect Solid– Key features

- ✓ Applications for thermal simulations



Volume meshed --  
TetraRapid

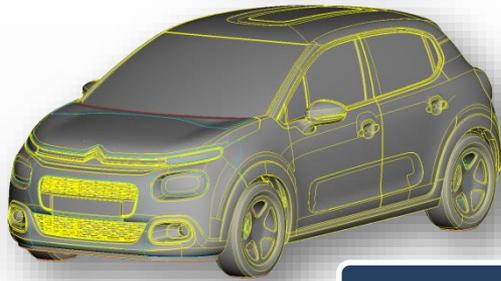
## Verification of resulting watertight mesh



## S.Graph – Key features

- ✓ Direct comparison between different ANSA models

## Target performance goals



Geometry



Surface mesh

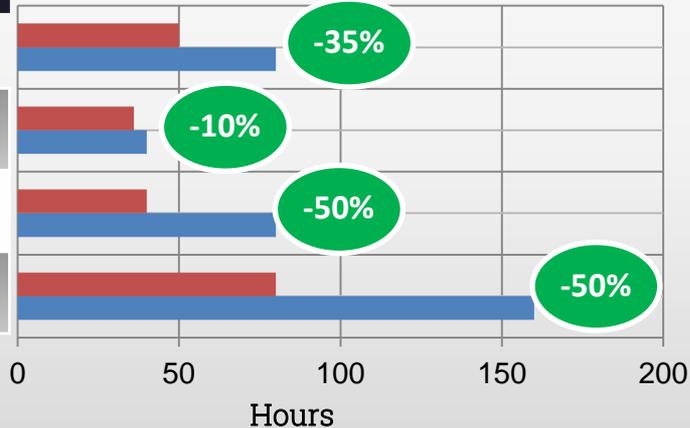
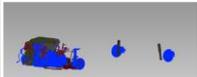
## New Methodology – Key features

- ✓ Improved turnaround processing times
- ✓ More Consistent Quality
- ✓ Enable users with less experience to build complex models
- ✓ High level of automation and modeling standardization – ANSA scripting



### Performance pre-processing times

Merging of Sub assemblies



■ New methodology  
■ Old methodology



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SIMULATION SOLUTIONS

**PSA**  
GROUPE