

AutoCFD5 – Meshing TFG context and summary

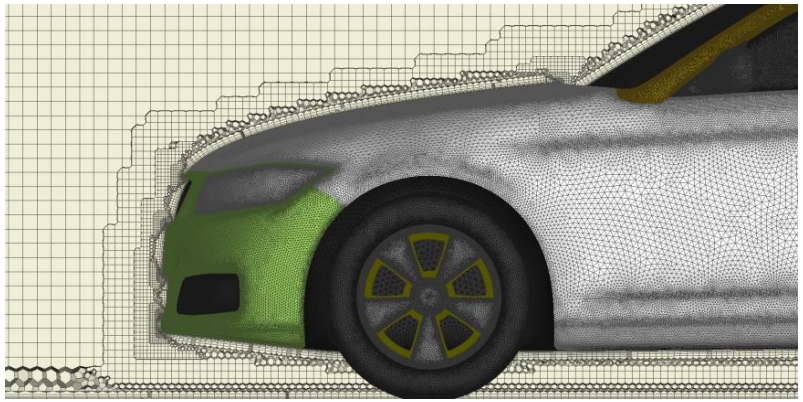
Vangelis Skaperdas, CFD Product Engineering Director

October 8-9th 2026, CINECA, Bologna, Italy

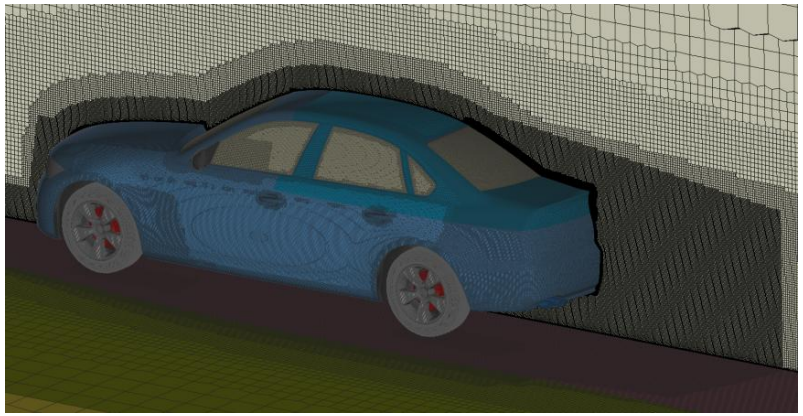
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Overview of AutoCFD Case 2 meshes

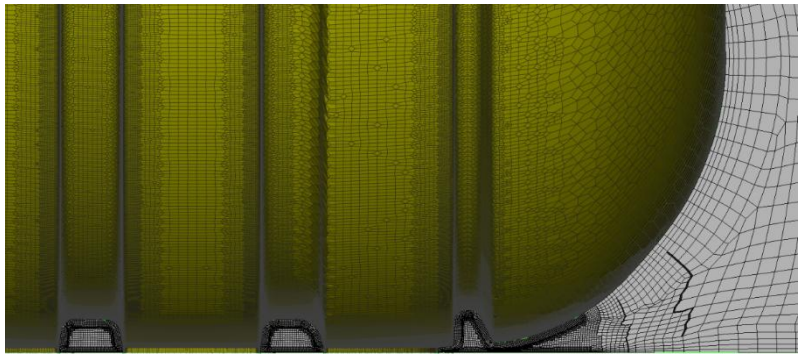
AutoCFD 1: Fastback and Estate
Surface to Volume
y+1 mesh 165 million cells (medium size)
Including mesh refinement study



AutoCFD 2&3: Notchback
Volume to Surface meshes
y+1 mesh 245 million cells
wall function mesh 128 million cells
No mesh refinement study



AutoCFD 4: Notchback (with and w/o deflector)
Volume to surface meshes
wall function 157 million cells
No mesh refinement study



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Objectives of Meshing TFG for AutoCFD5

Provide improved committee meshes with respect to the AutoCFD4 meshes

- Remove unnecessary over-refined areas to reduce the cell count
- Reduce the number of layers
- Add more mesh resolution in areas that were not fine enough
- Improve the mesh quality for more CFD solvers
- Provide three mesh refinement levels

Many thanks to the key contributors of this TFG:

- Nils Thome, Ford
- Maurice Nayman, Multimatic
- Miguel Class, TotalSim USA

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Comparison of the committee meshes of the last two workshops

	AutoCFD-4 (ANSA v24.1.3)		AutoCFD-5 (ANSA 2025.2.0)	
	Case 2a Notchback	Case 2b (deflector) Notchback	Case 2a Notchback	Case 2b (deflector) Notchback
Number of shell elements (million)	11.2	11.3	**10.3**	**10.4**
Number of vol elements (million)	157	158	**123**	**126**
First layer height (mm)	0.75		**0.75**	
Number of viscous layers	7		**5**	
Growth rate	1.2 – 1.4 variable		**1.2 – 1.4 variable**	

Speed: ~30min on AMD Ryzen threadripper PRO 9995WX

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Summary of new meshes available for download for AutoCFD-5

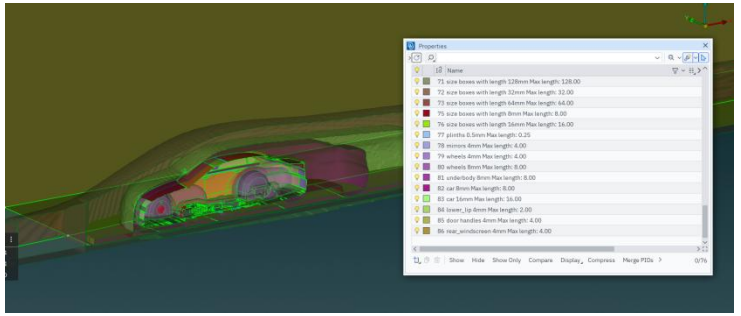
- Volume meshes at three mesh refinement levels and in **OpenFOAM**, **Fluent** and **CGNS** formats with the following cell count (in millions):

	Coarse	Medium	Fine
Case 2a – Notchback baseline	66	**123**	260
Case 2b – Notchback with deflectors	67	**126**	267

Notes: Check the PID names if you are using previous setups, as there have been some renamings.
All meshes are in metres units

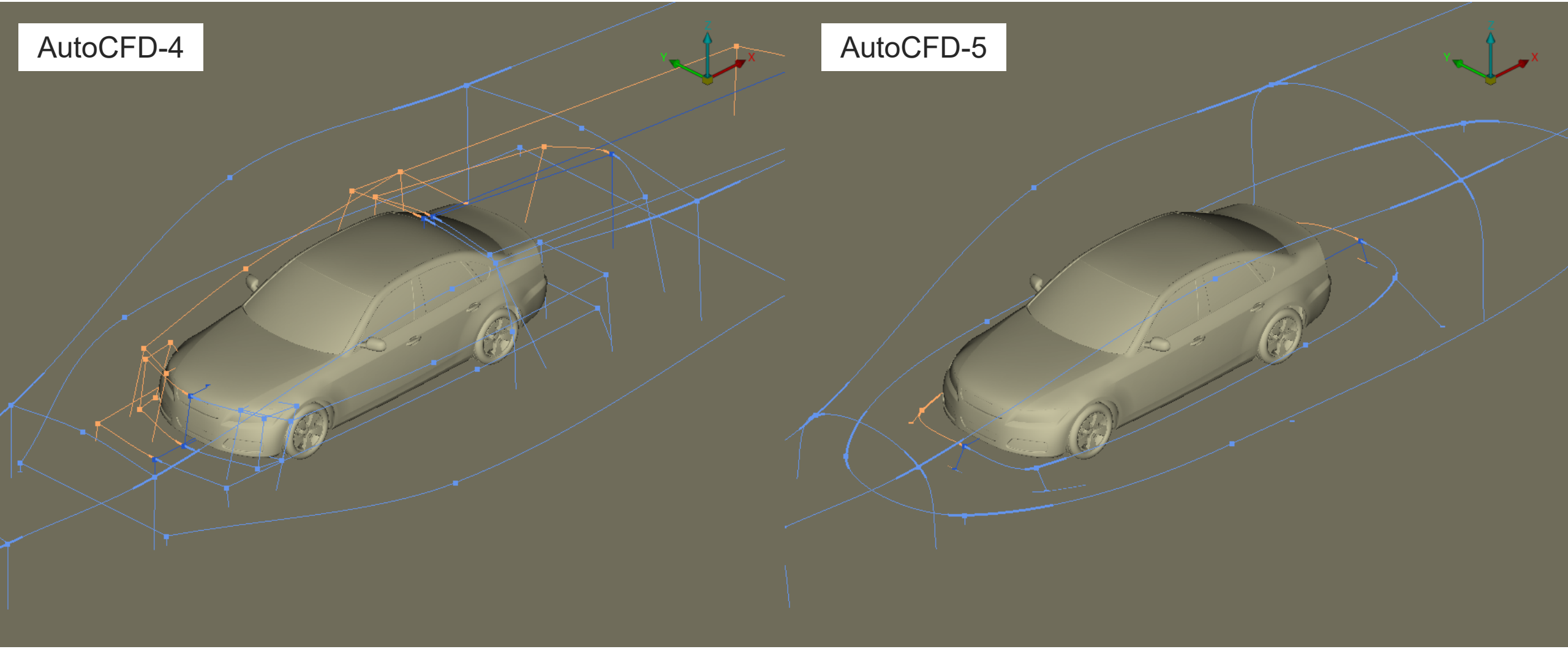
- Model geometries available in STL format together with 3D descriptions of refinement zones in space. Each iso-surface is named according to the max length it imposes

Model Geometries	Refinement Zones
DrivAer Notchback baseline	DrivAer Notchback baseline
Additional front wheel deflectors	Refinement zone of wheel deflectors



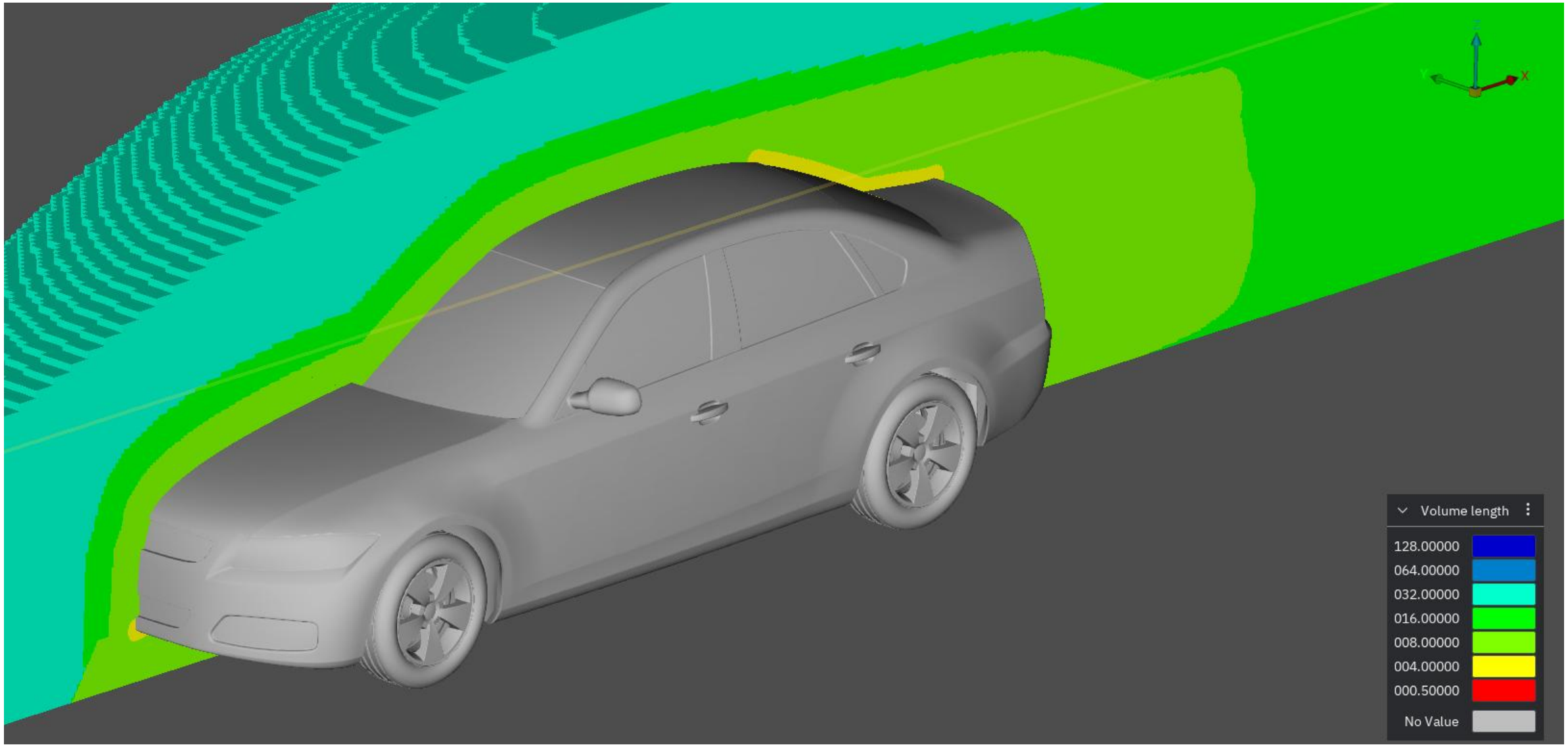
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Simplification of Size Boxes



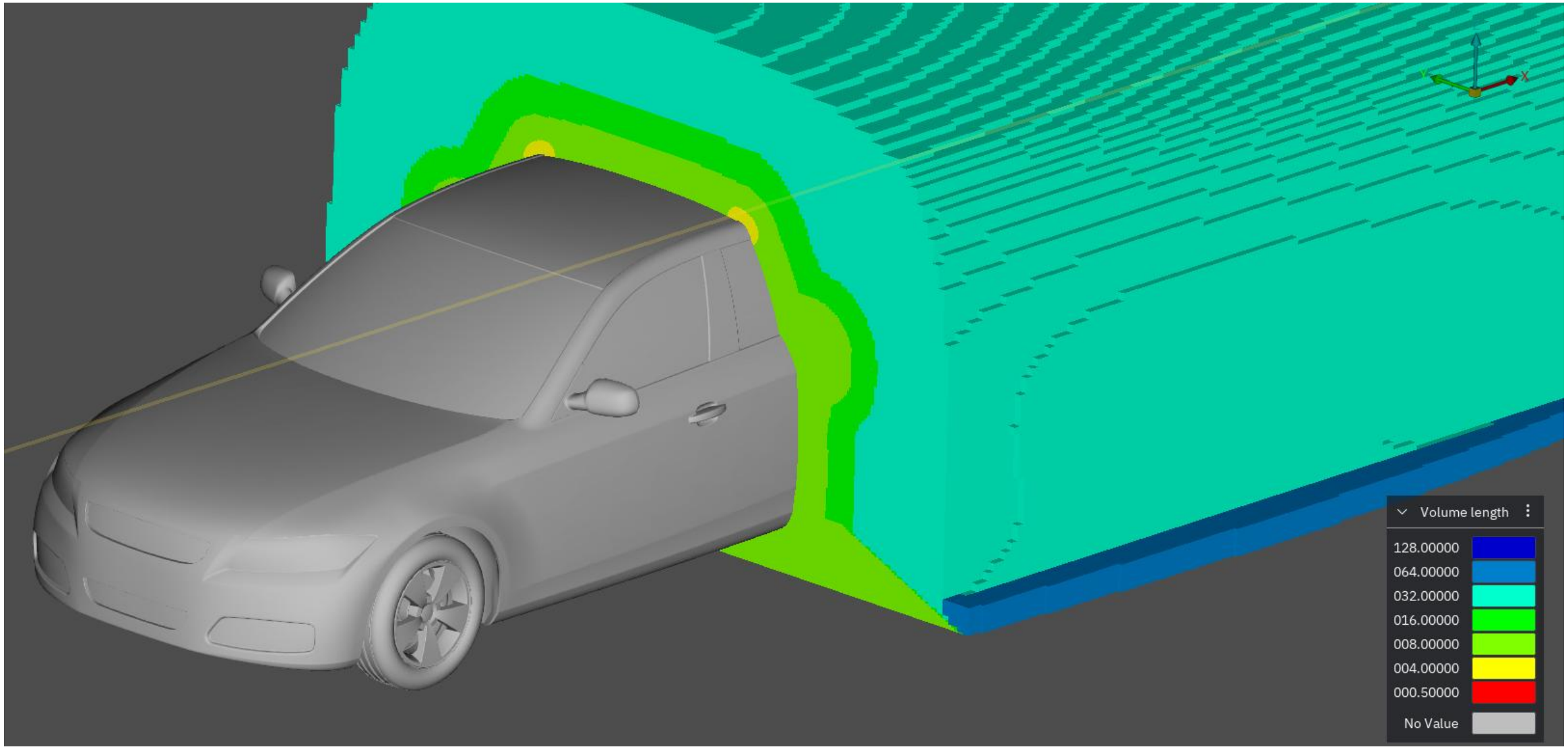
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New setup relies more on Surface Offset and sweep size rules



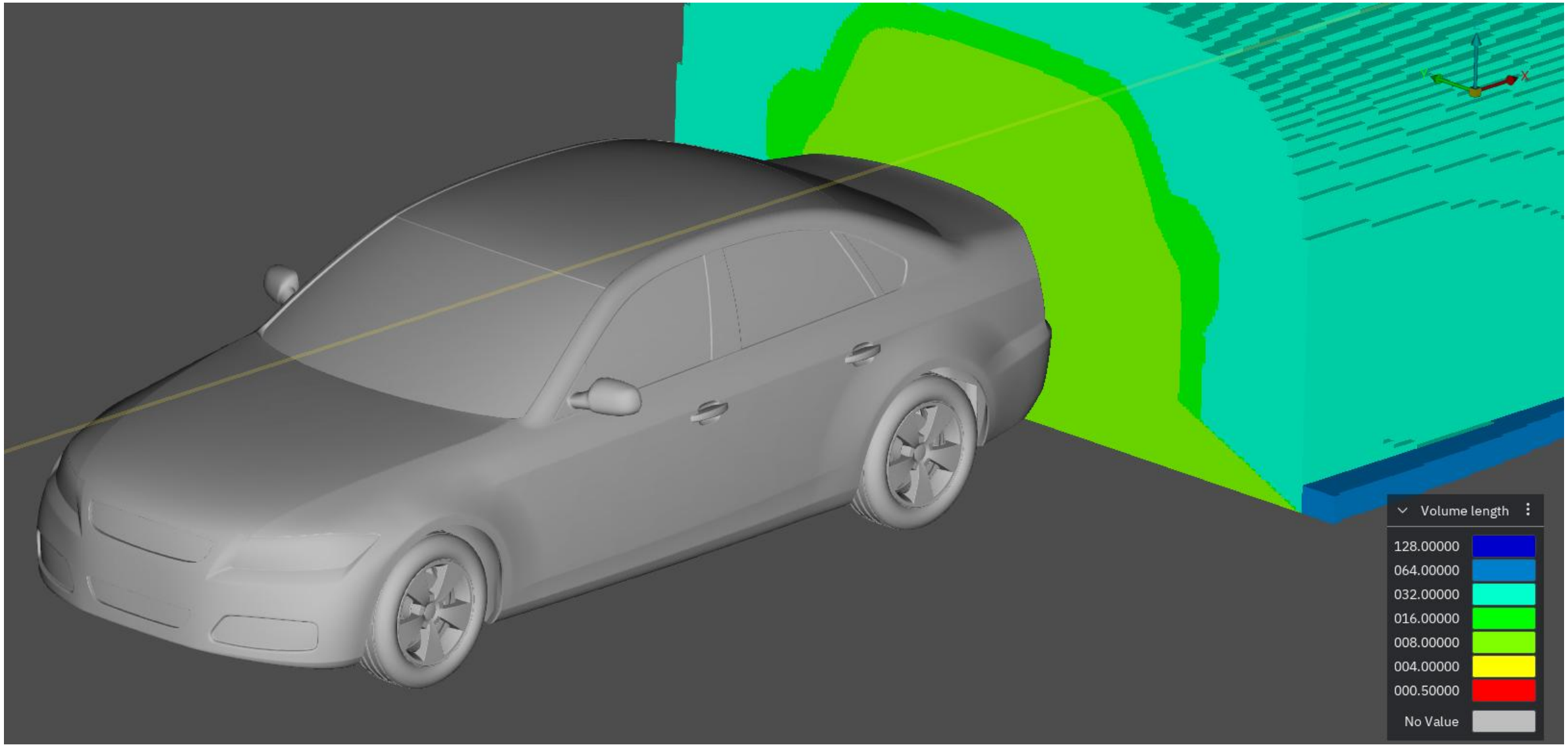
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New setup relies more on Surface Offset and sweep size rules



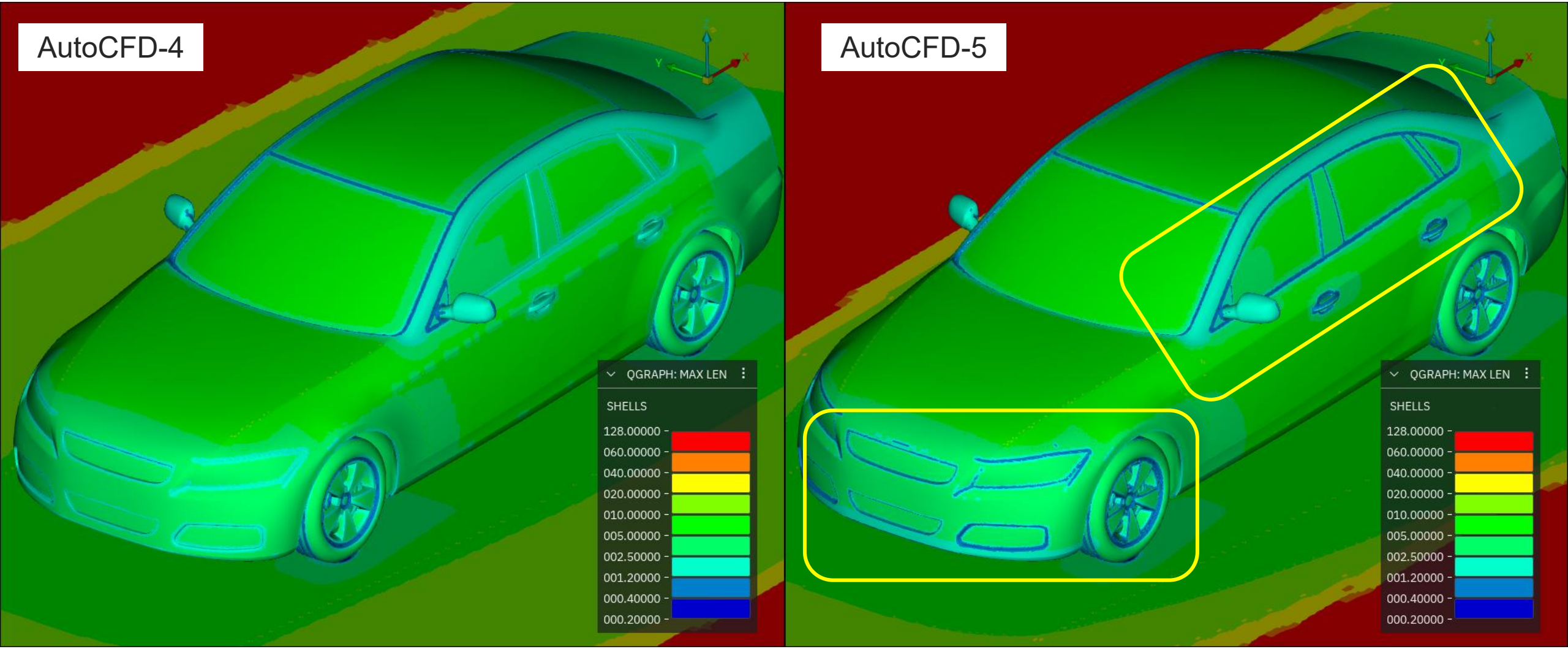
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New setup relies more on Surface Offset and sweep size rules



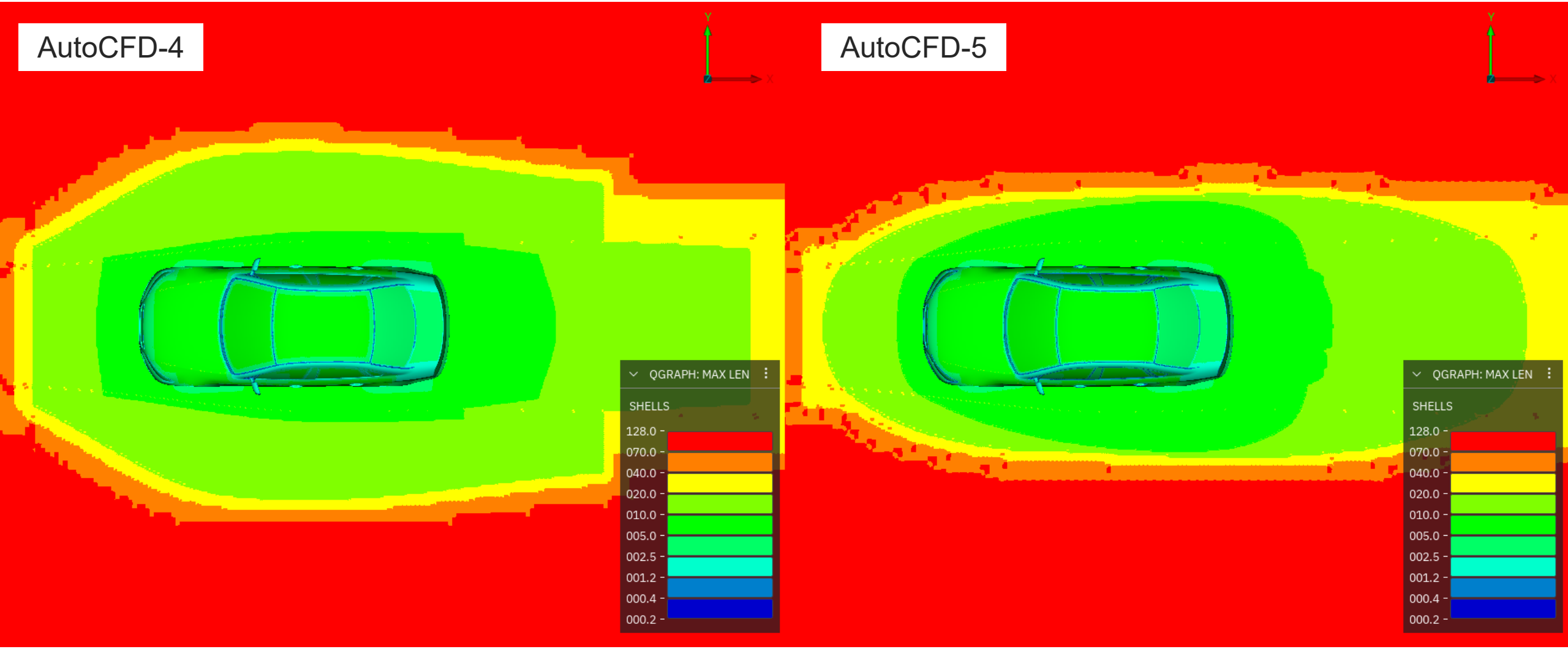
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Surface mesh size contour plot (mm)



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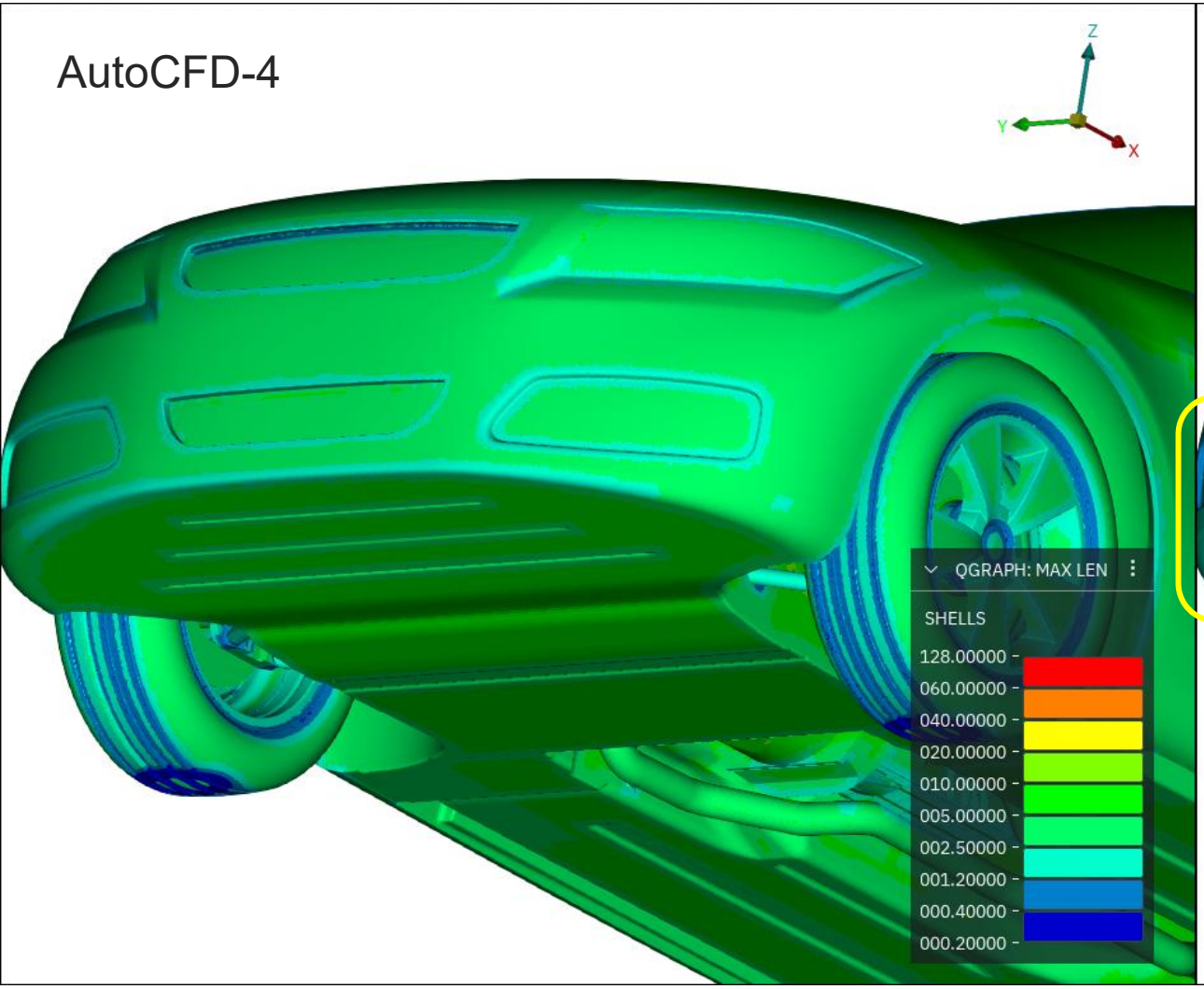
Surface mesh size contour plot (mm)



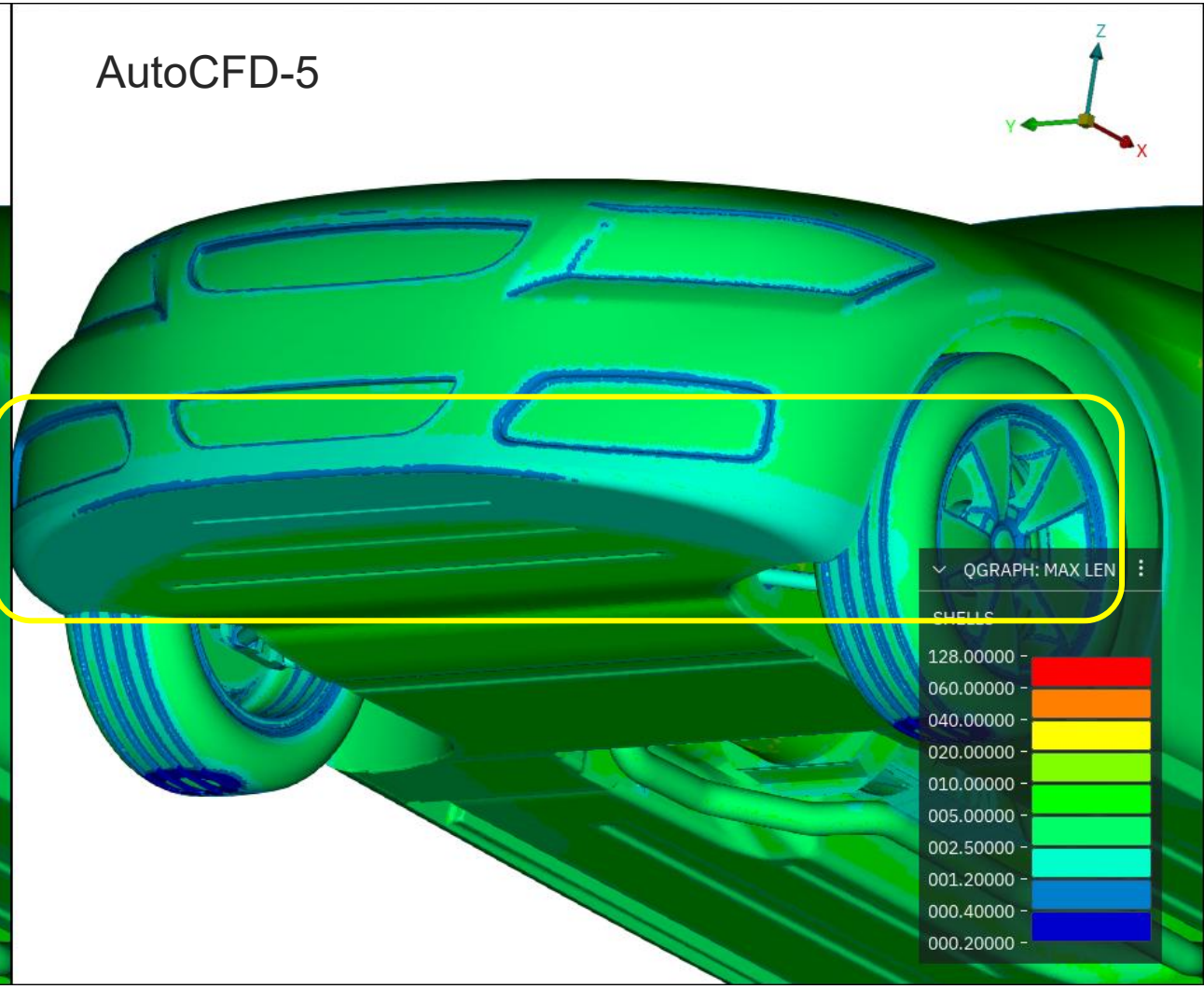
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Surface mesh size contour plot (mm)

AutoCFD-4

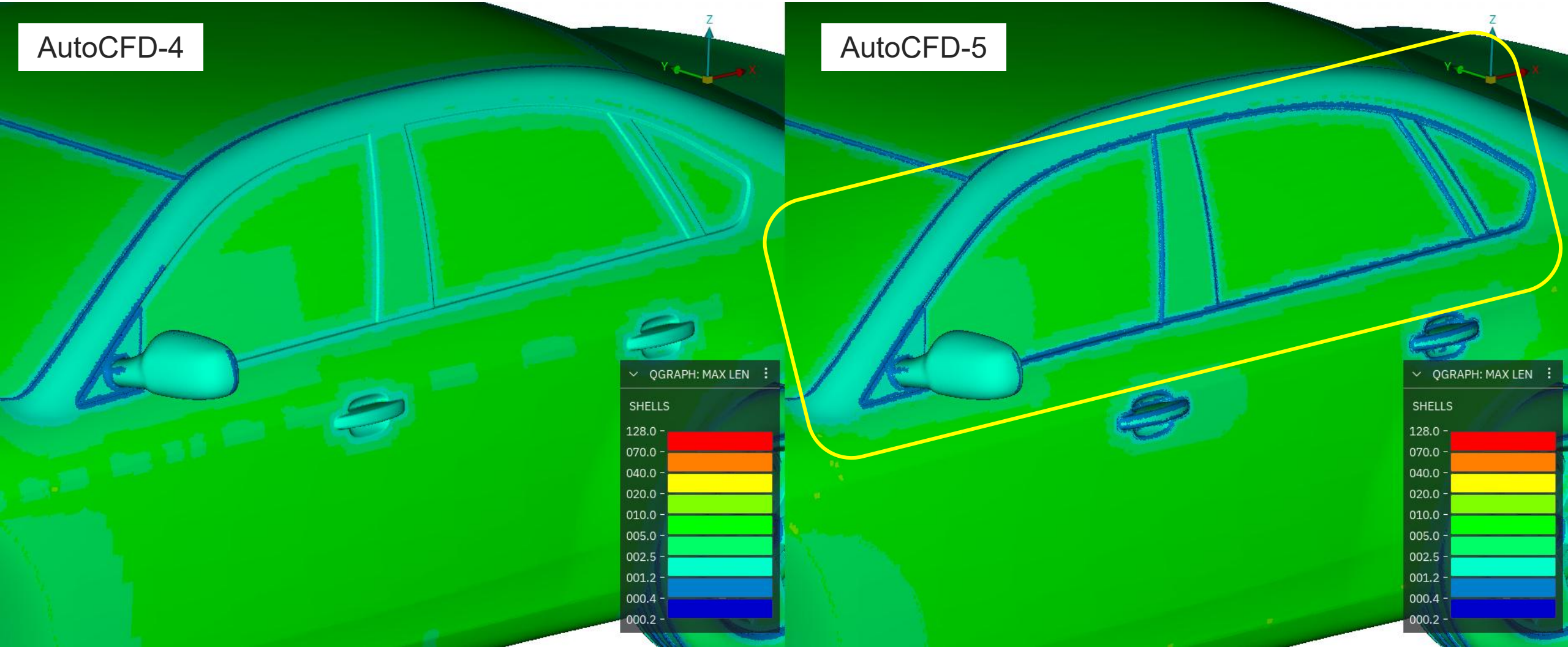


AutoCFD-5



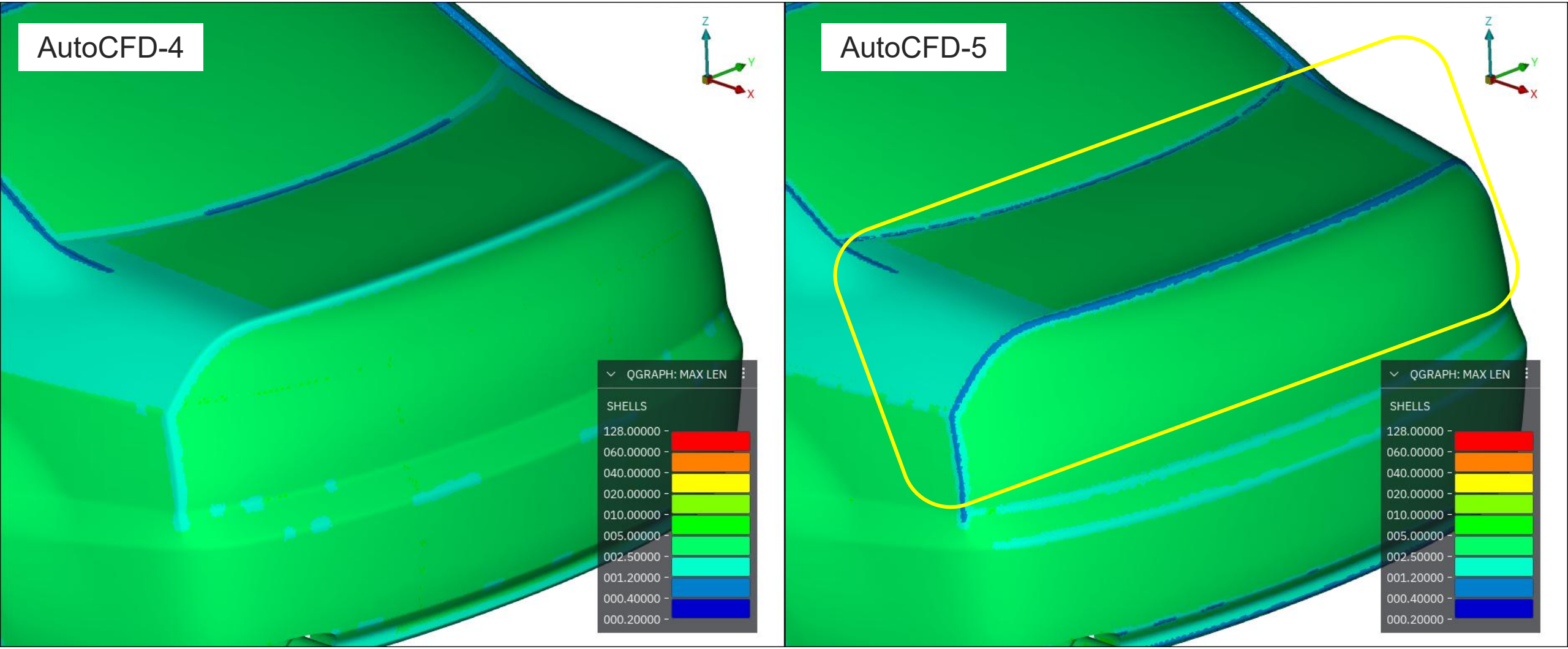
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Surface mesh size contour plot (mm)



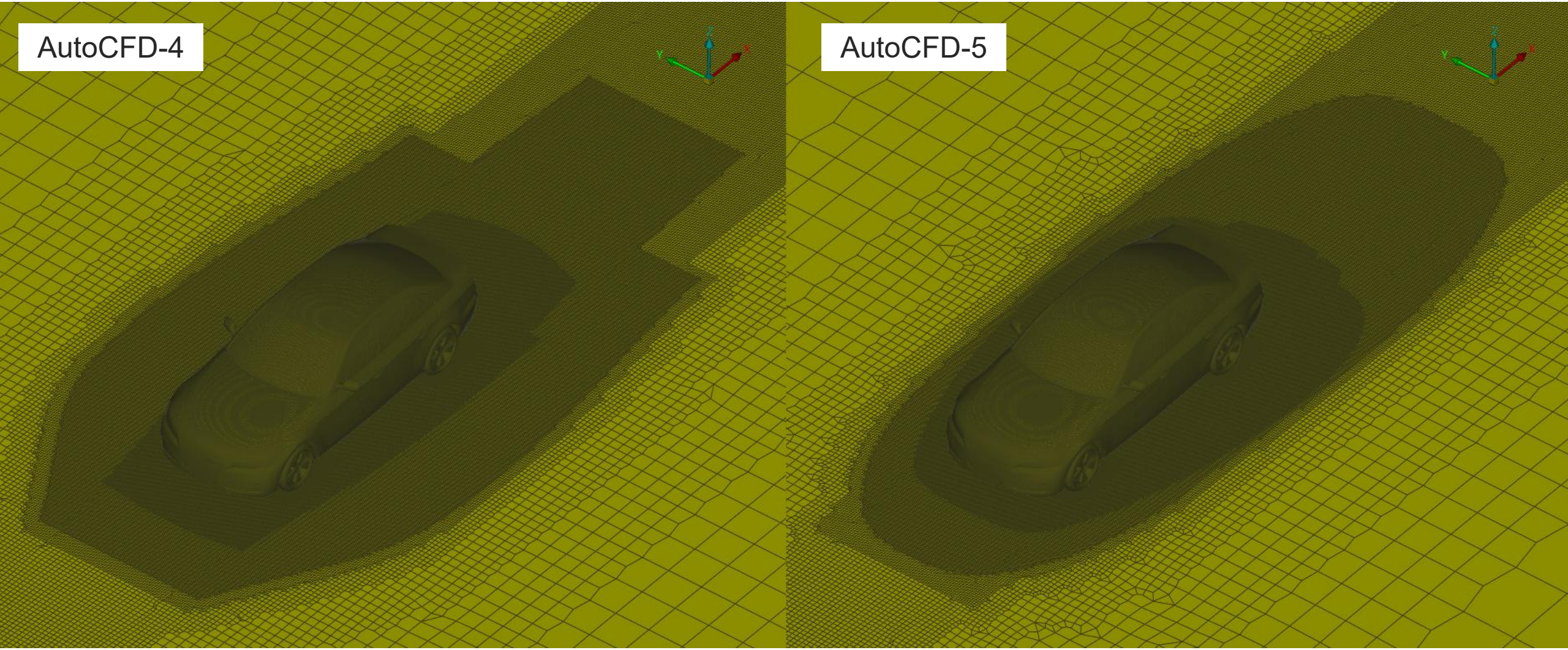
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Surface mesh size contour plot (mm)



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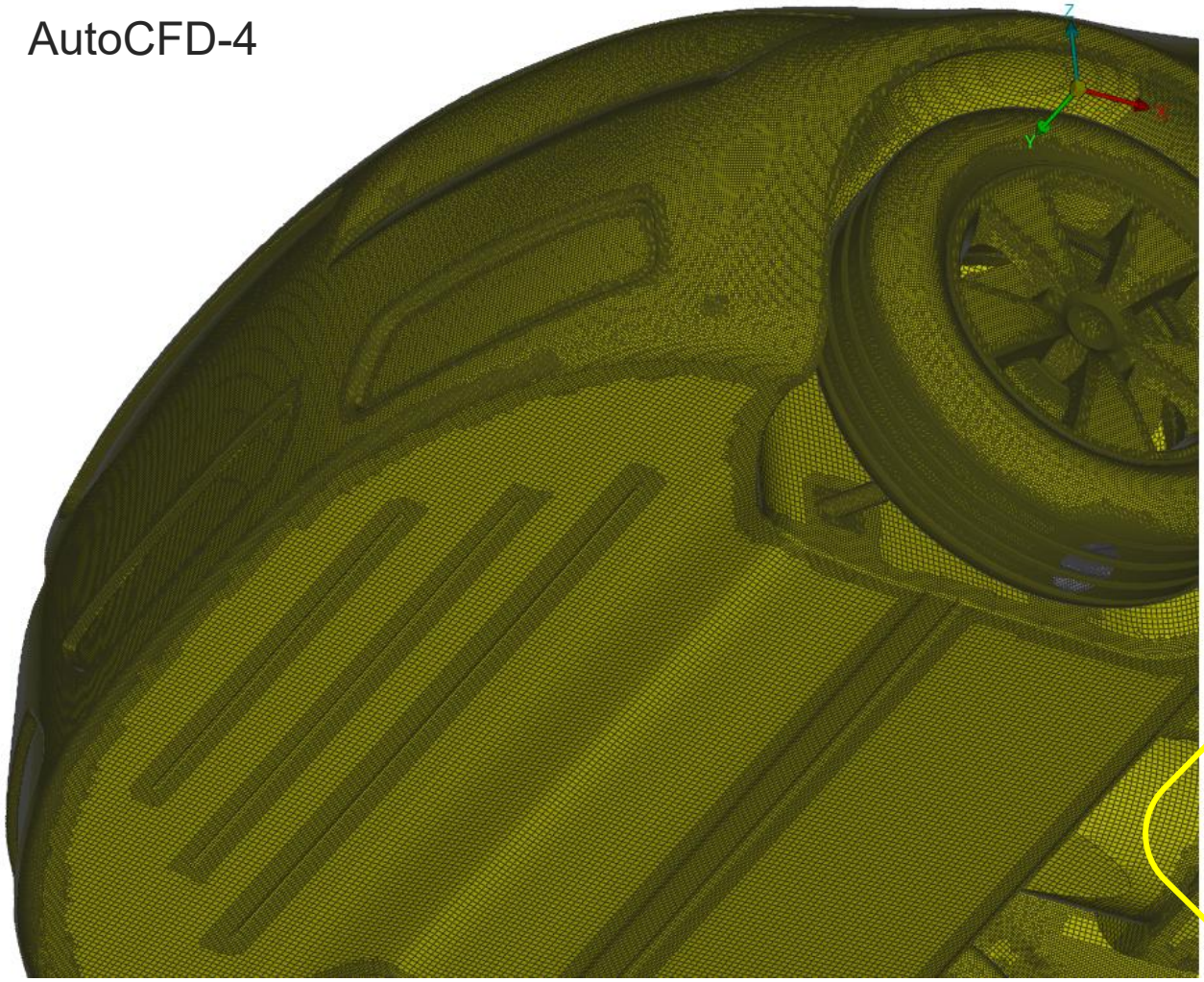
Surface mesh



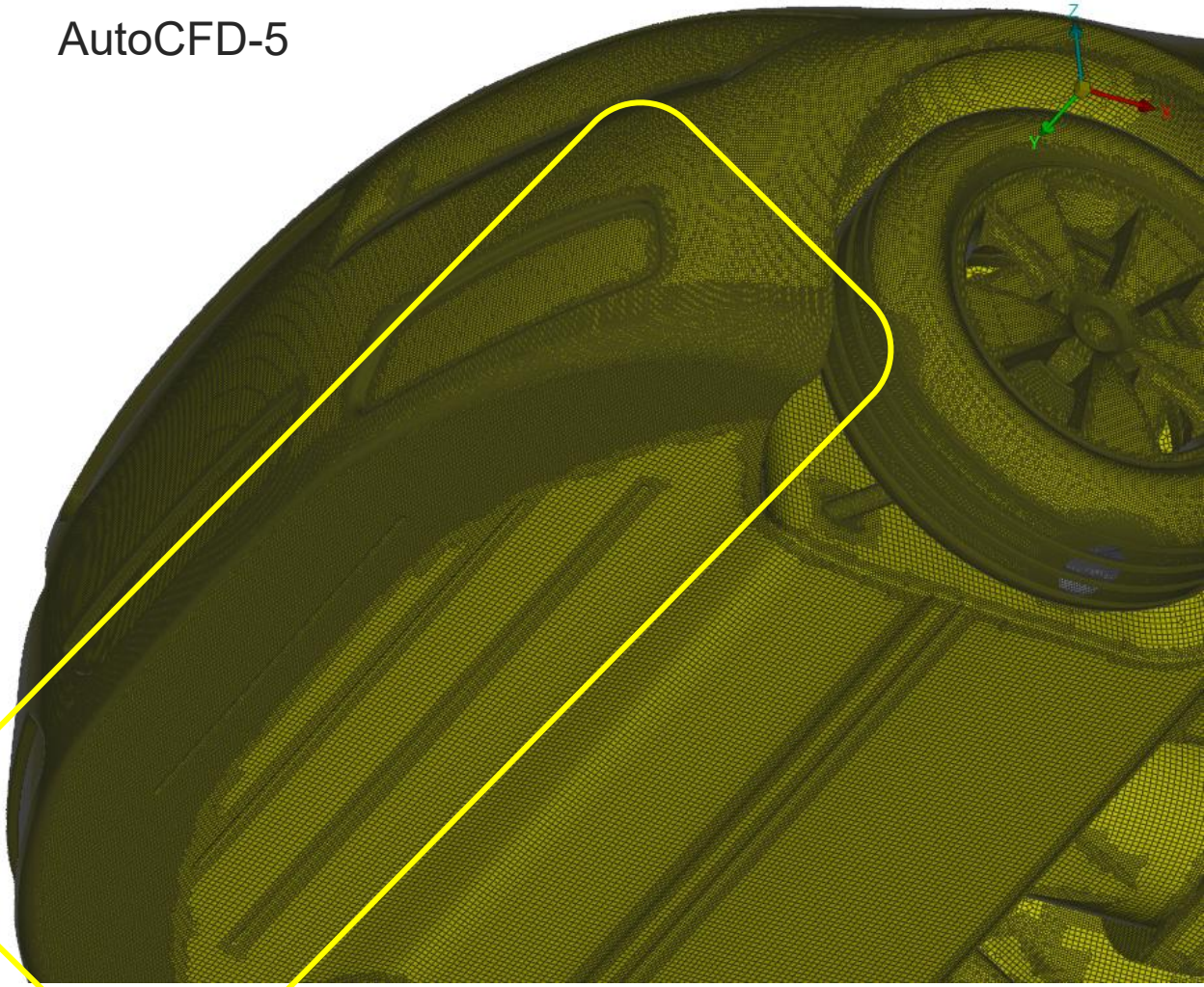
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Surface mesh – refined area at front facia lower lip

AutoCFD-4



AutoCFD-5

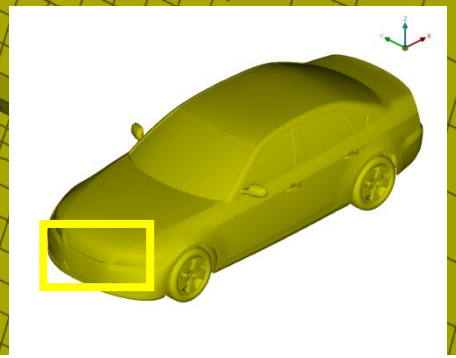


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Surface mesh size near front grill lip

AutoCFD-4

AutoCFD-5

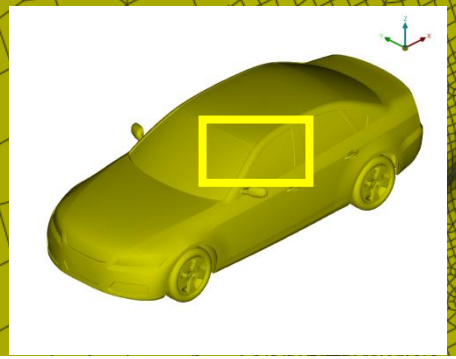


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Surface mesh near A-pillar region

AutoCFD-4

AutoCFD-5

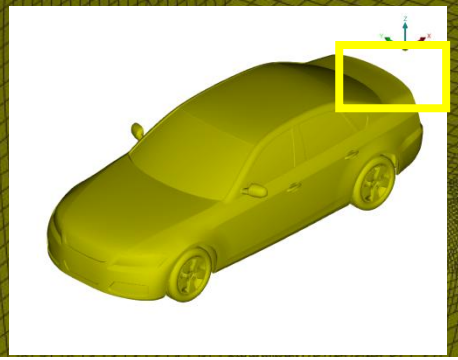


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Surface mesh at rear boot lip

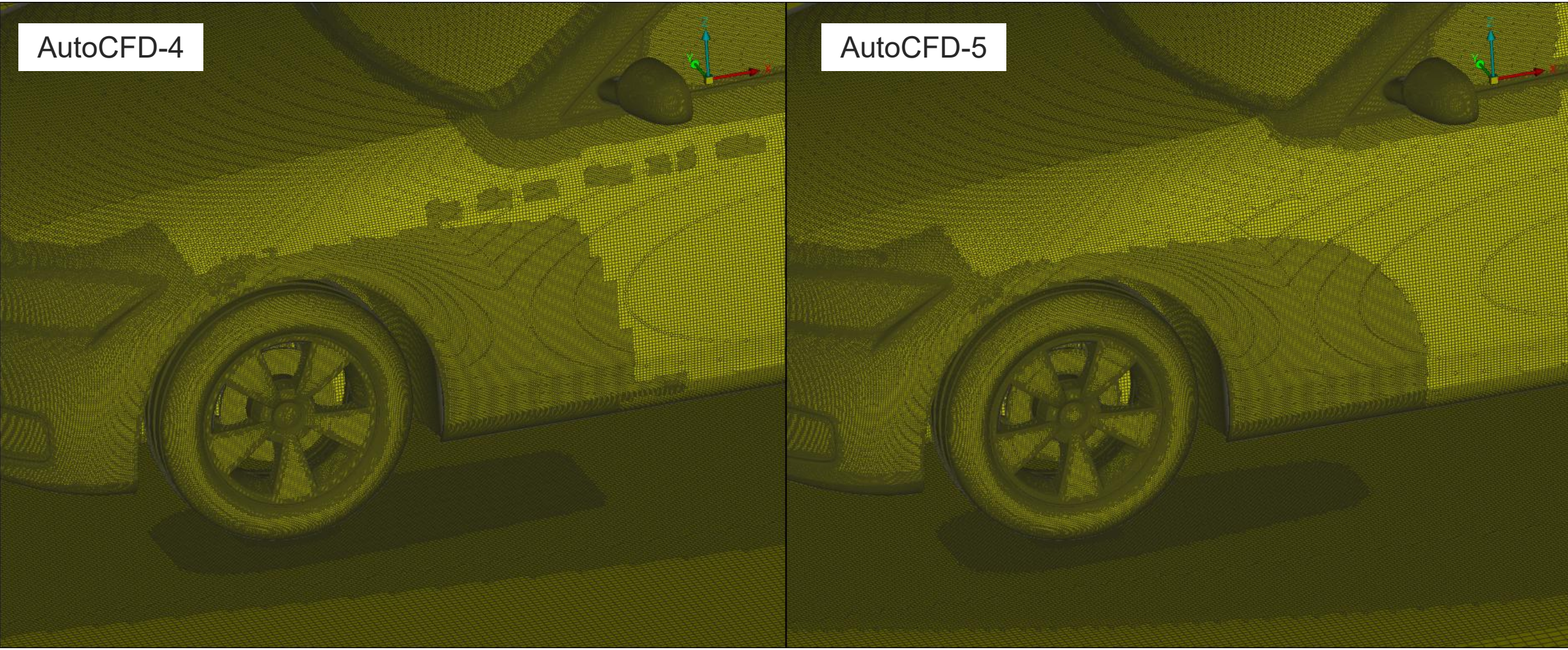
AutoCFD-4

AutoCFD-5



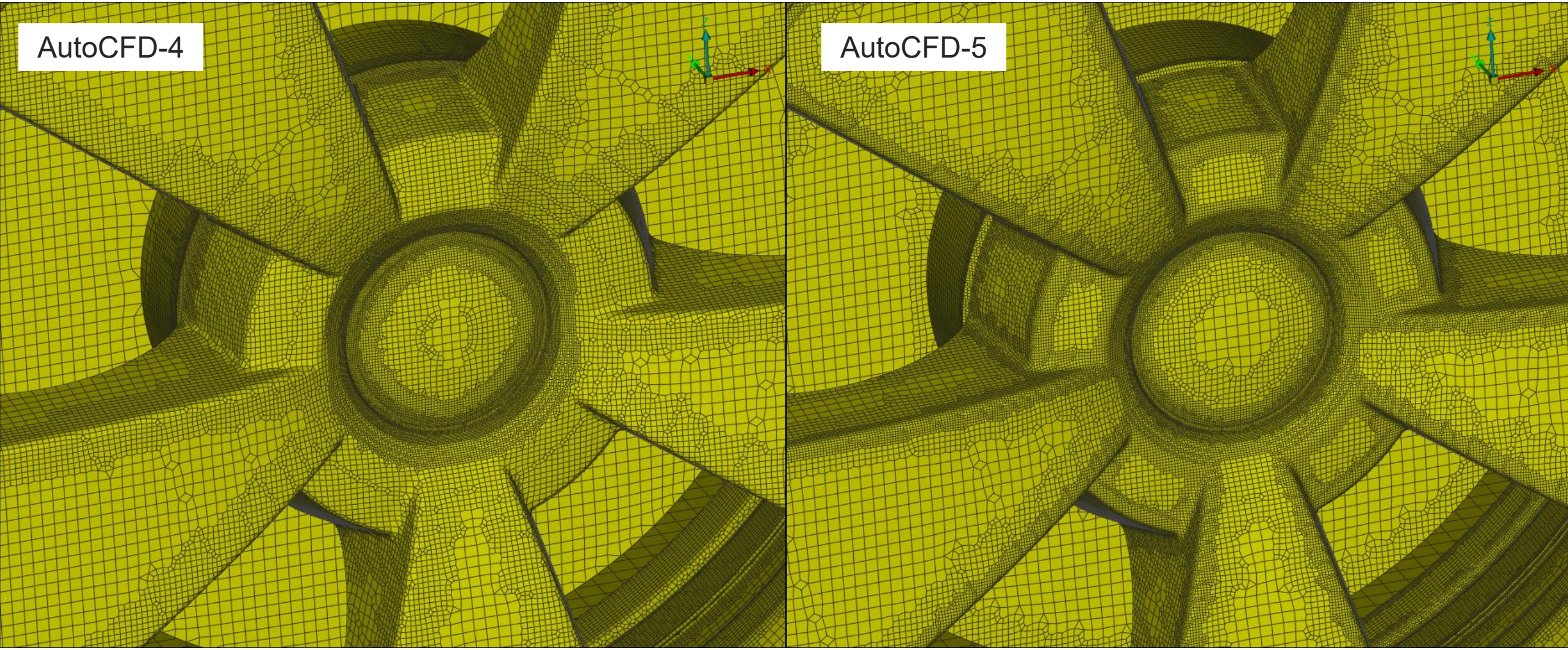
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Surface mesh – small reduction of mirror wake refinement



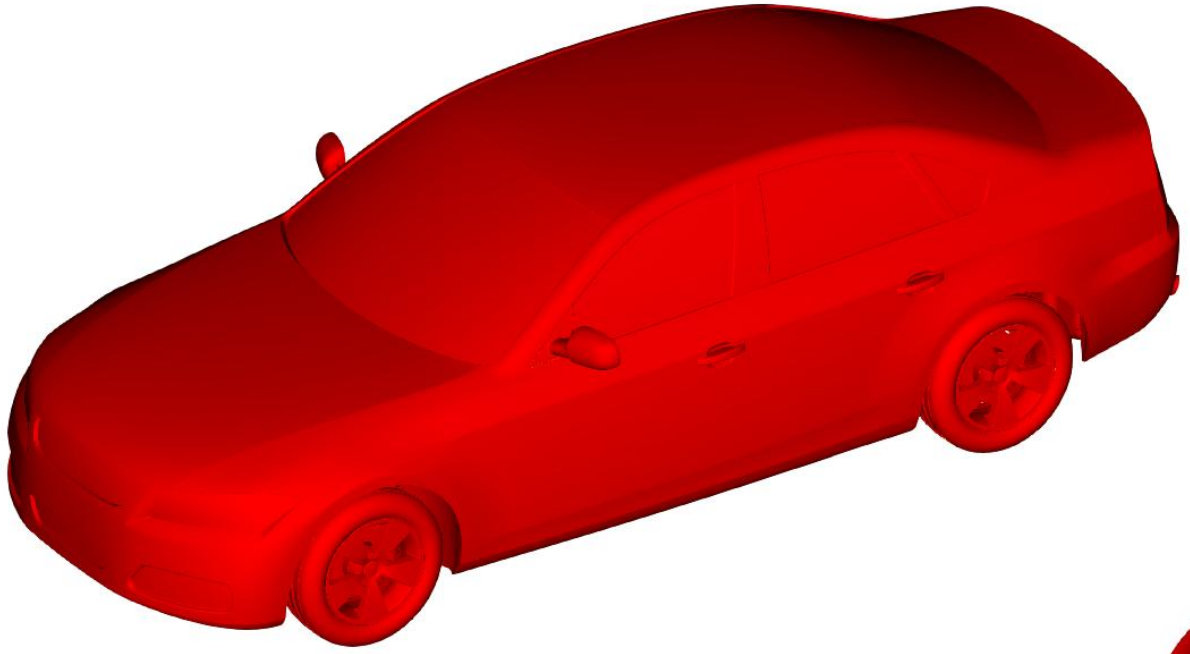
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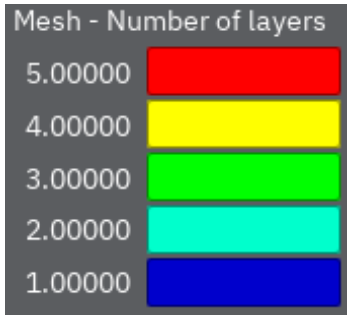
Surface mesh – small reduction of mirror wake refinement

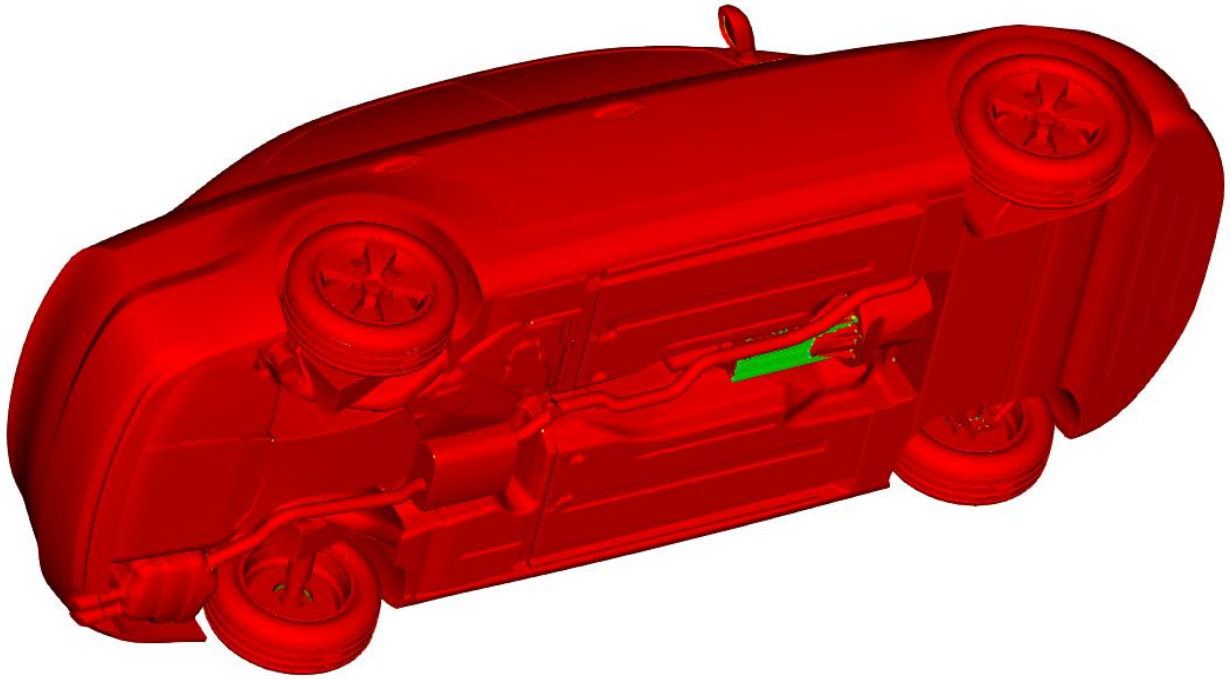


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Layer coverage contour plot

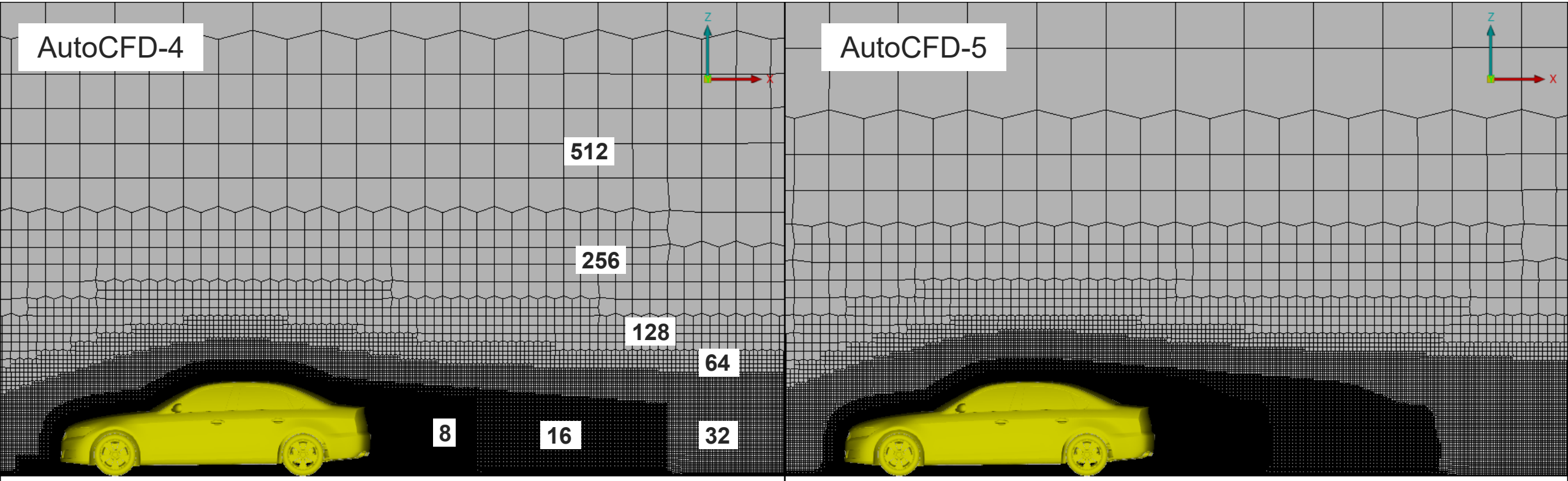






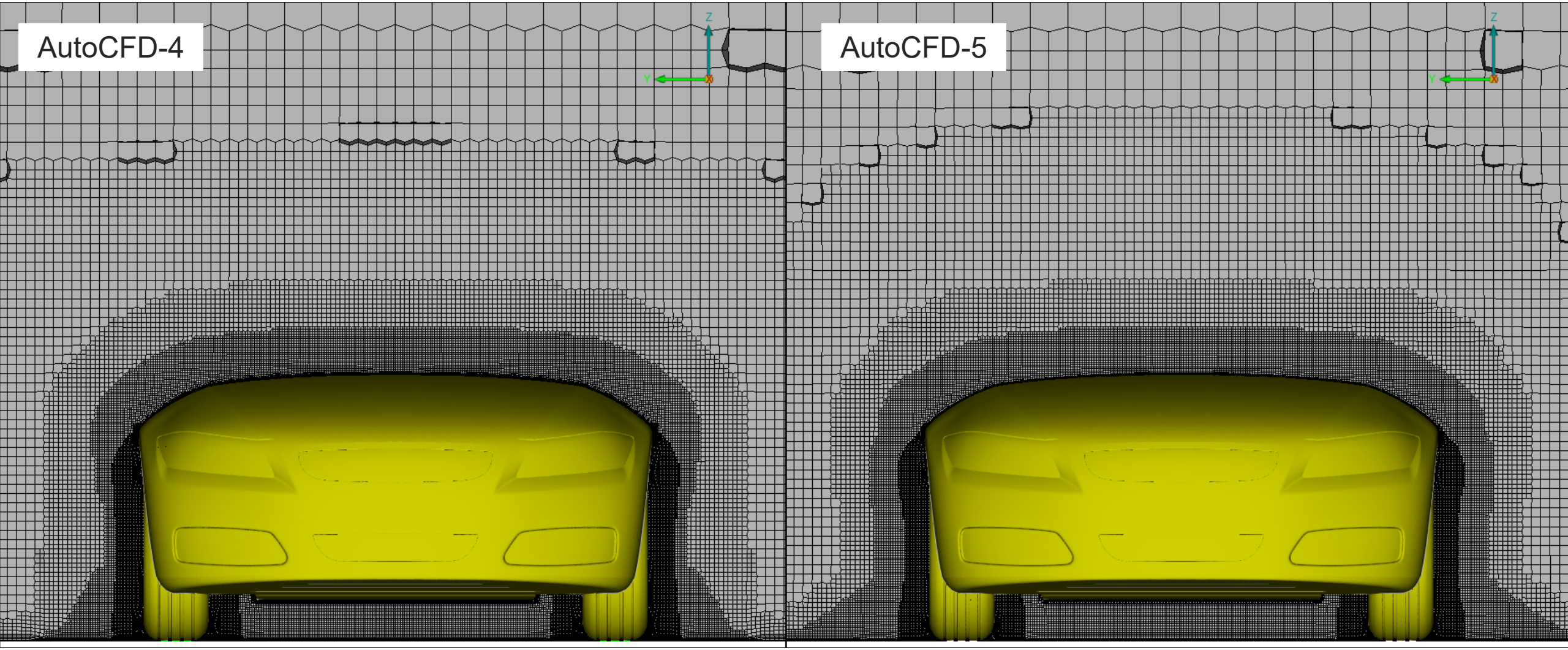
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Volume mesh



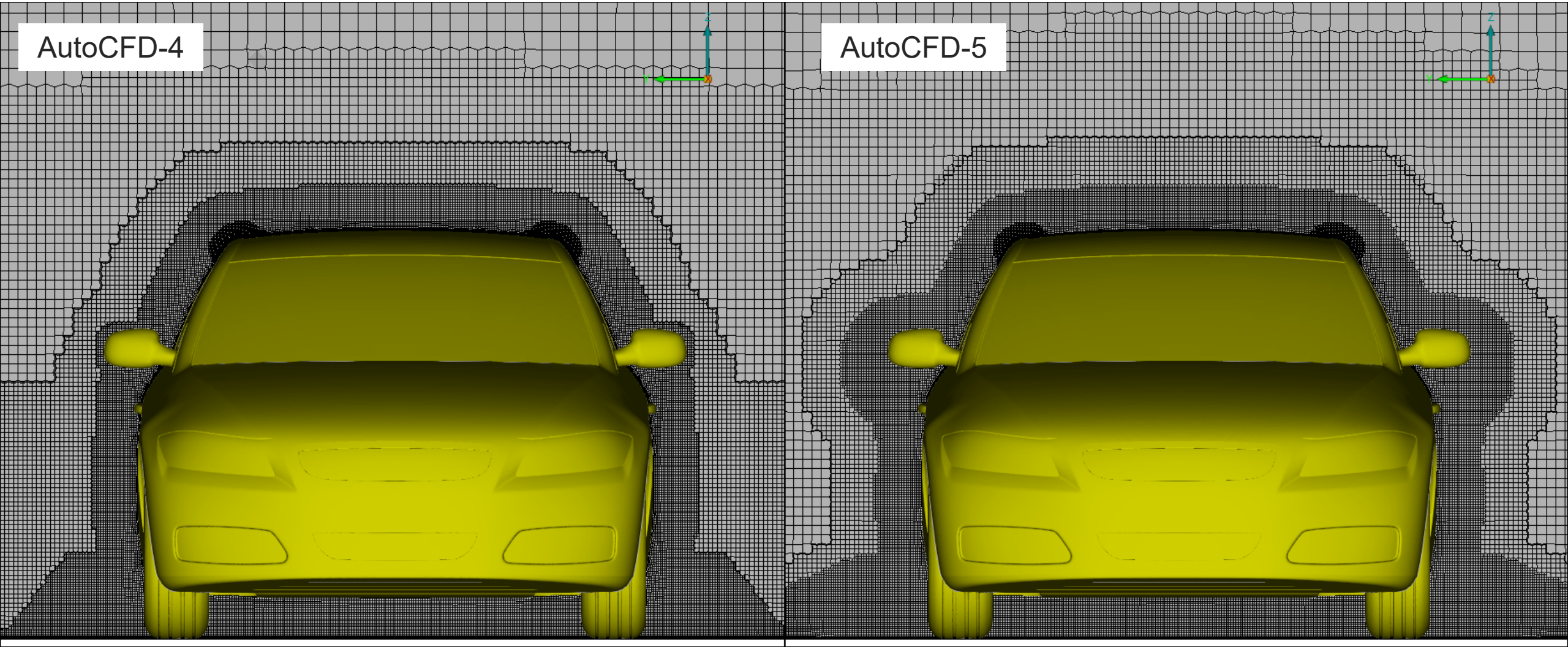
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Volume mesh at front wheel axis



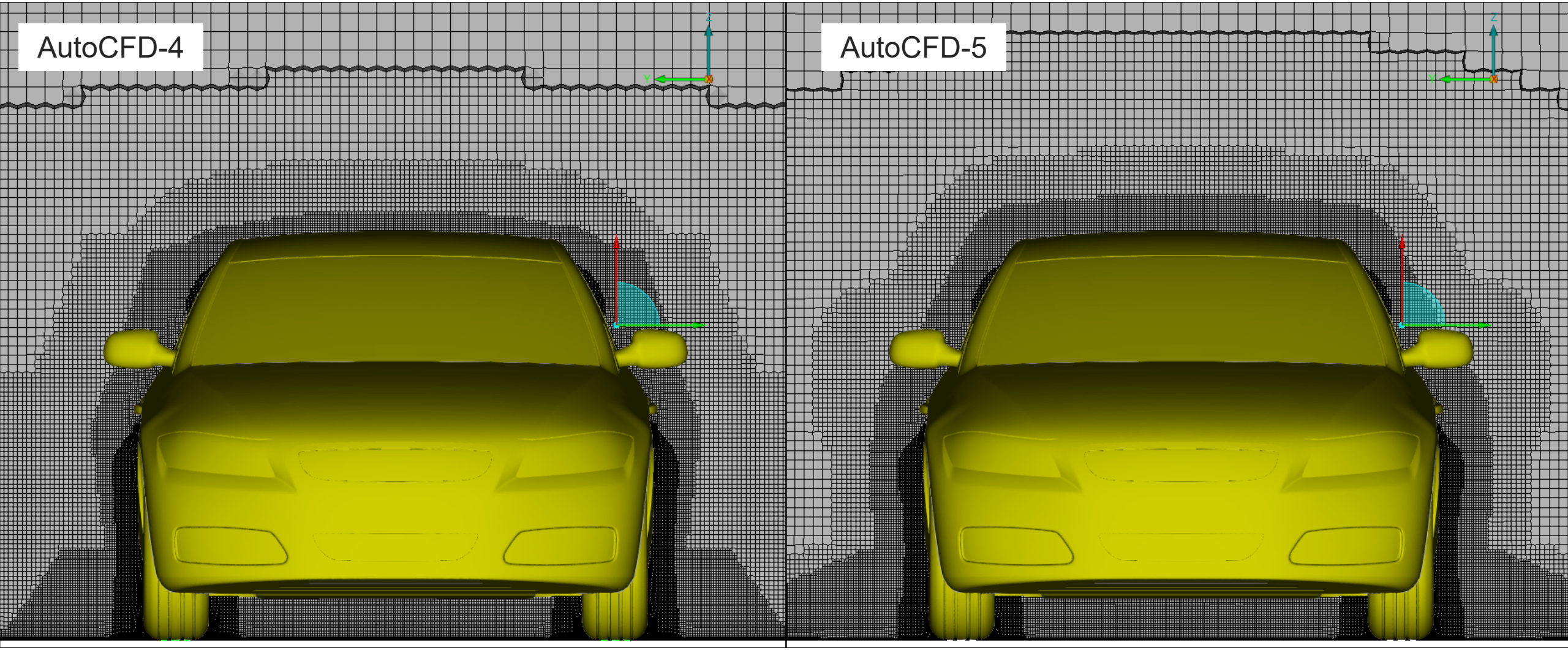
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Volume mesh at B-pillar



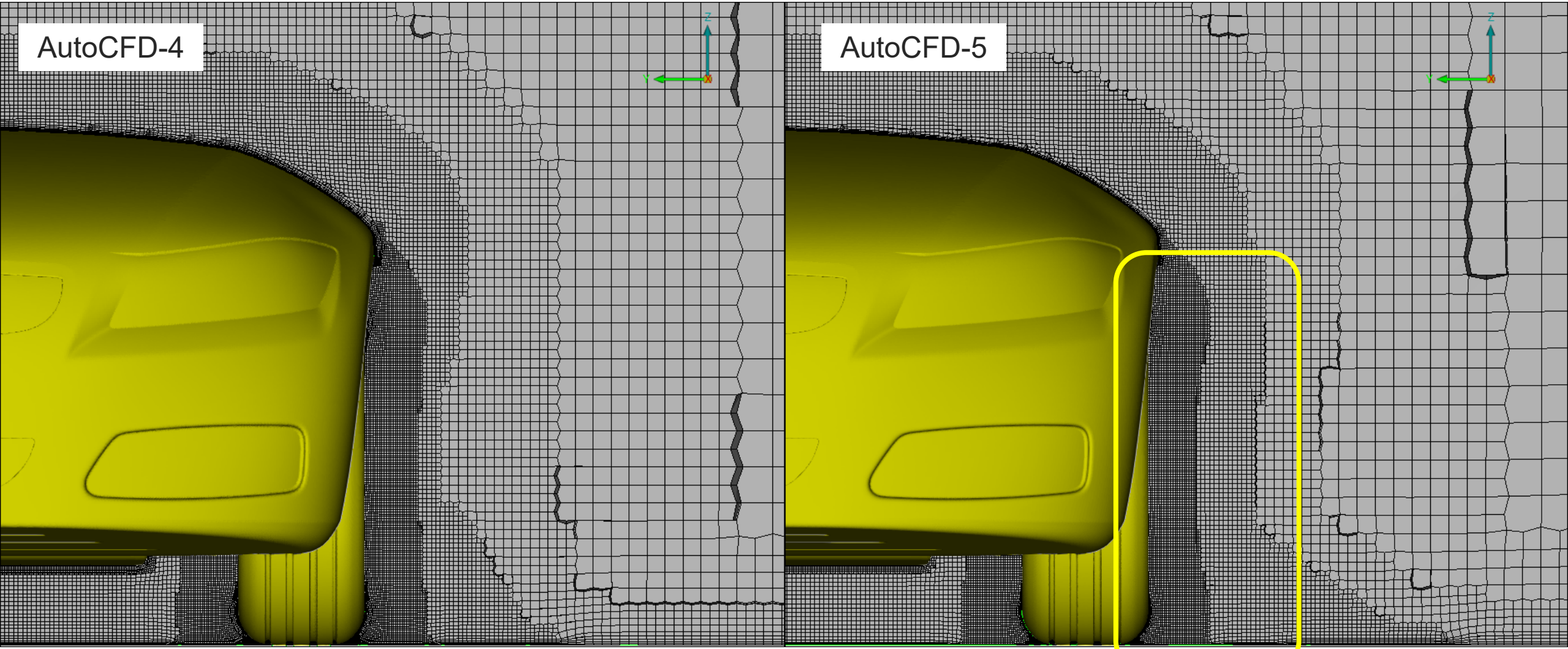
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Volume mesh at rear wheel axis



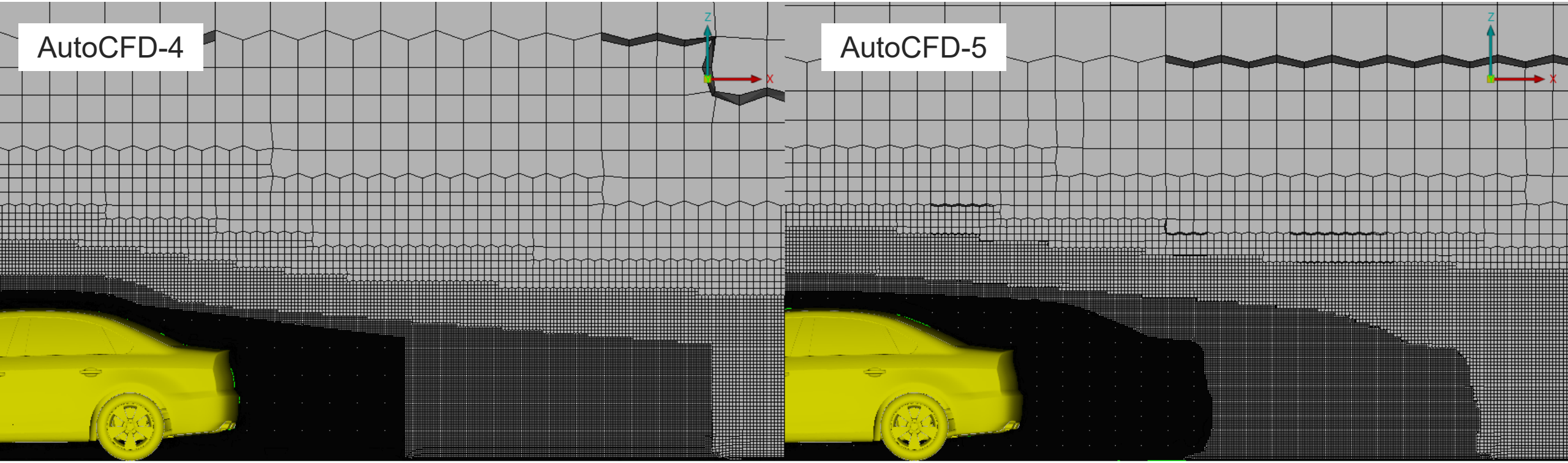
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Volume mesh at front wheel axis



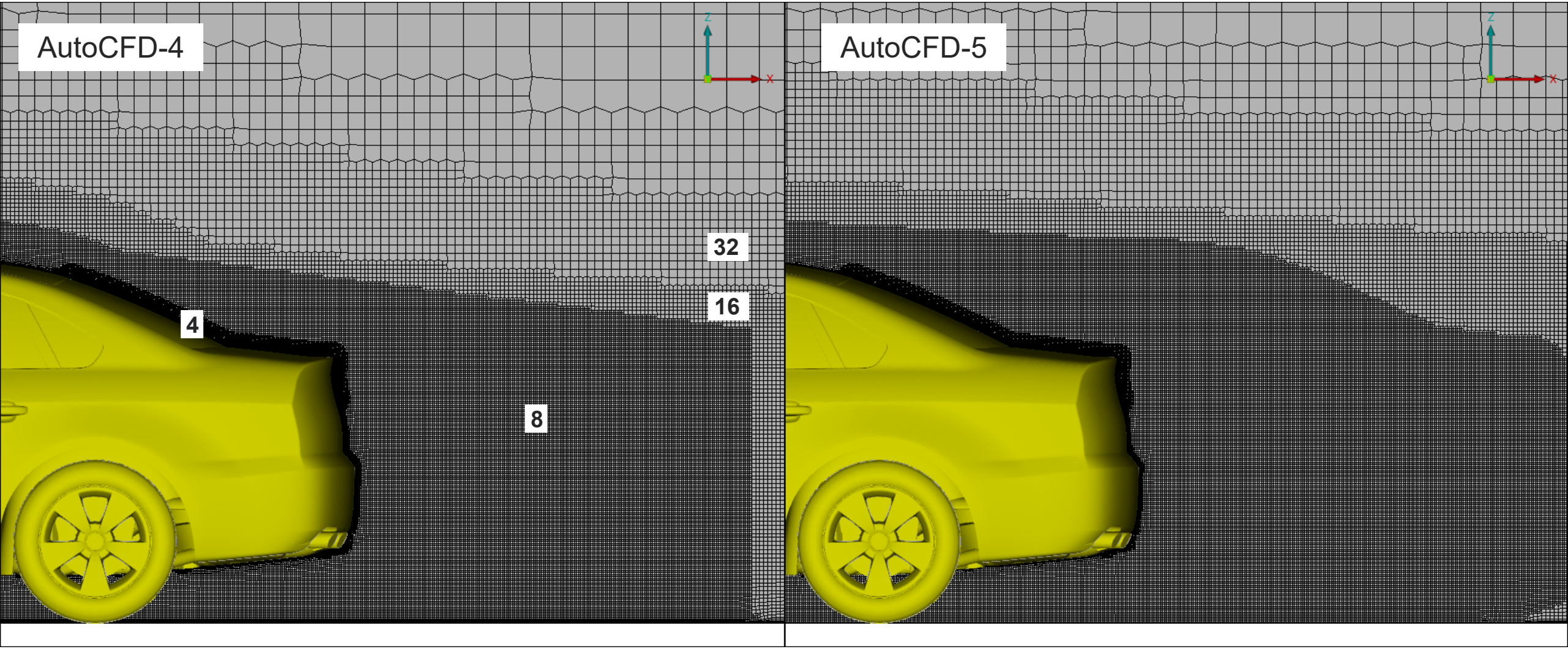
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Volume mesh – Size Boxes replaced by Surface Offset size rules



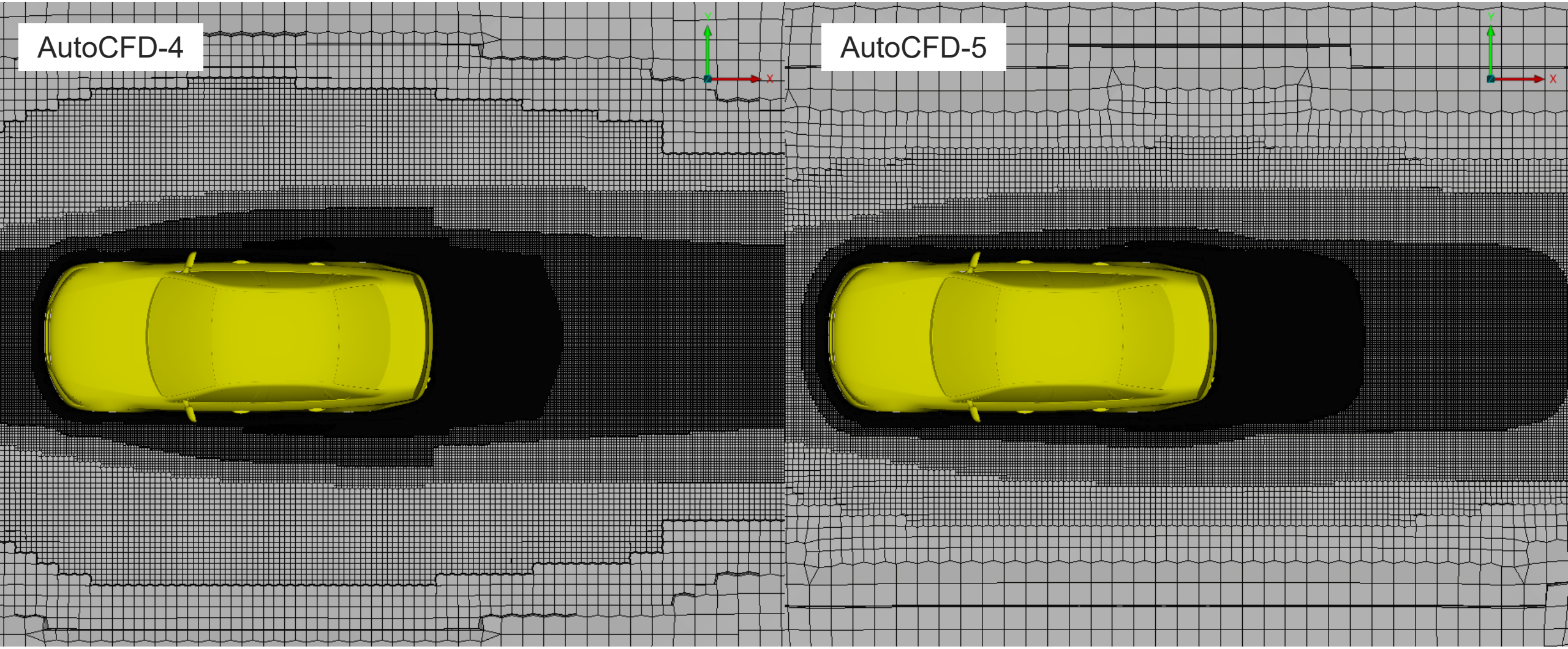
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Volume mesh – Size Boxes replaced by Surface Offset size rules



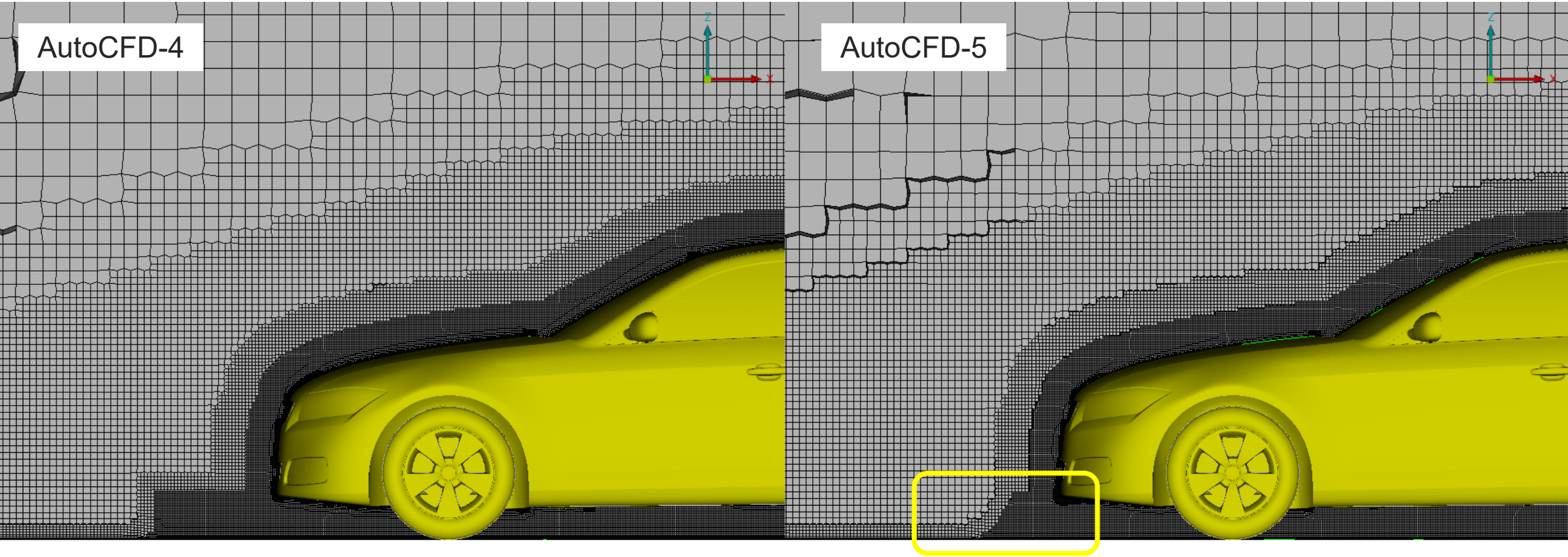
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Volume mesh – Size Boxes replaced by Surface Offset size rules



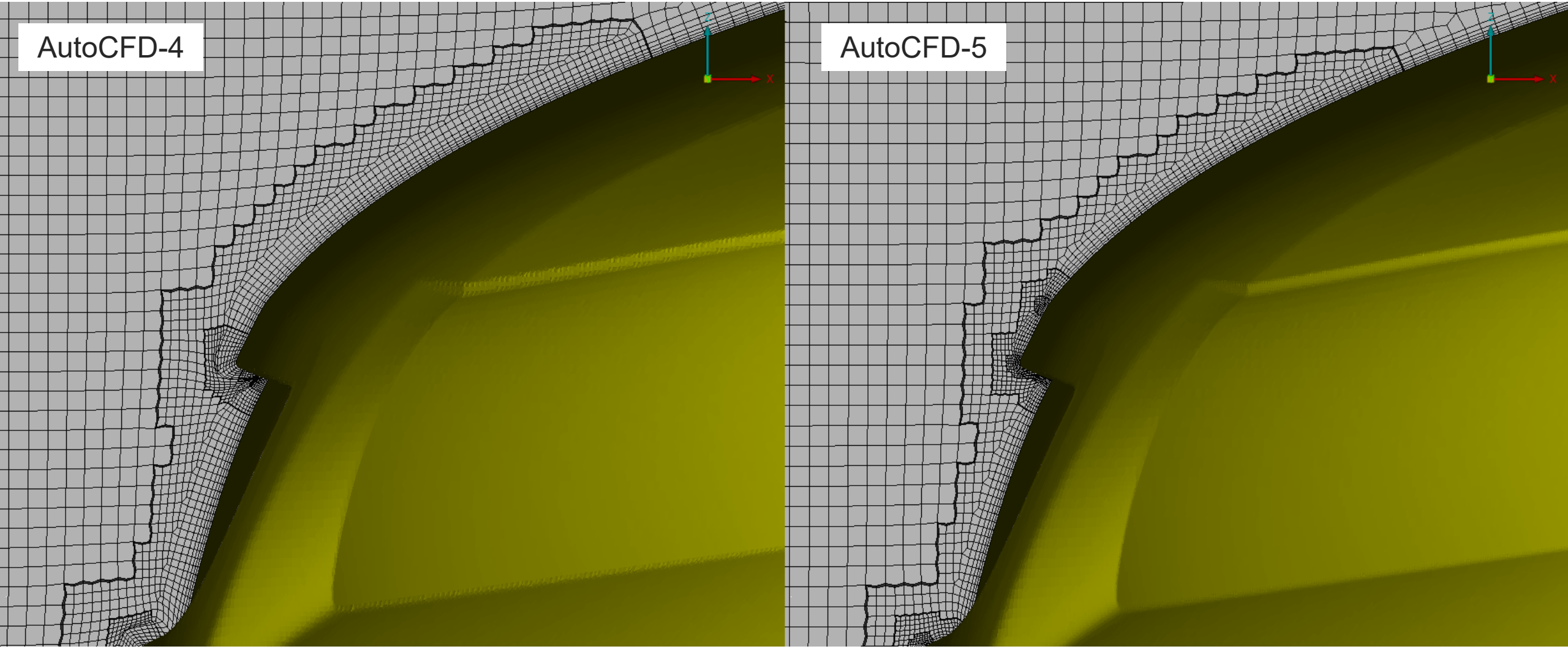
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Volume mesh – small reduction of upstream lower refinement area



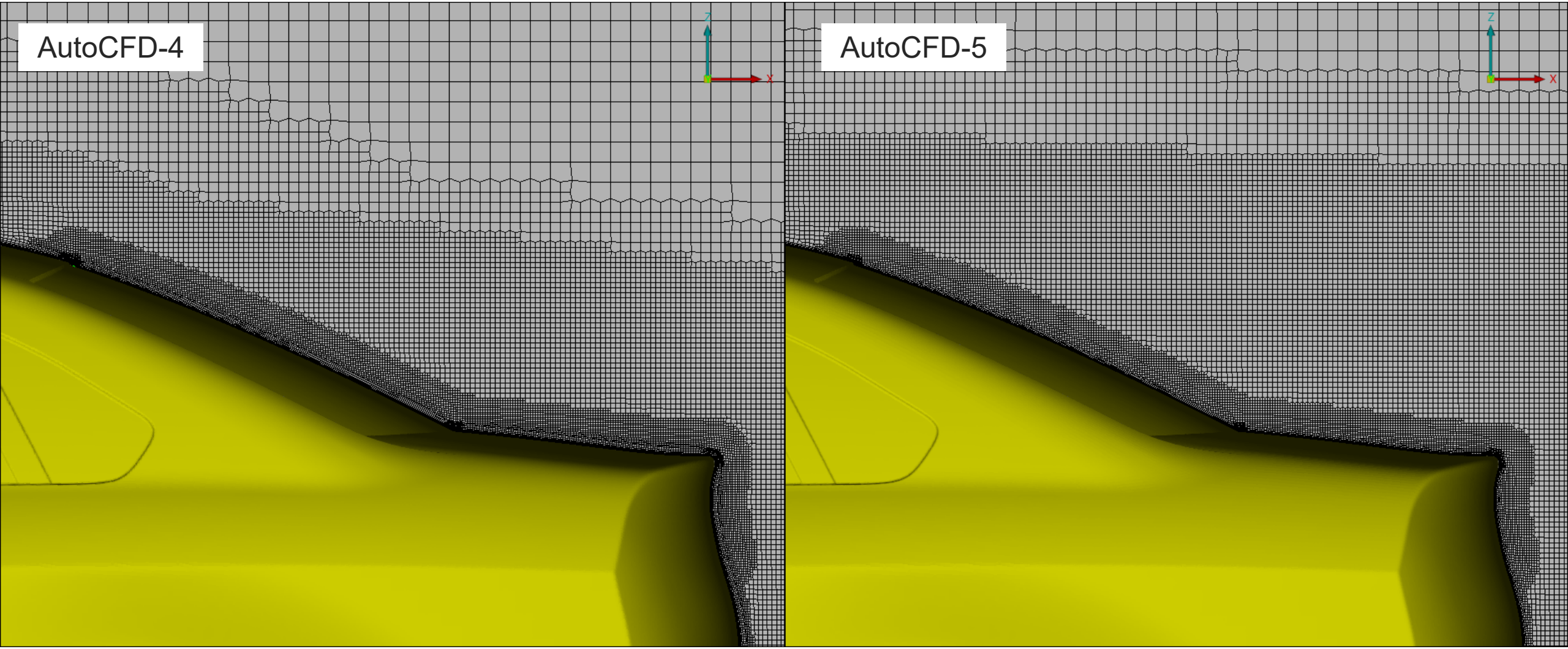
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Volume mesh – reduction of N layers from 7 to 5



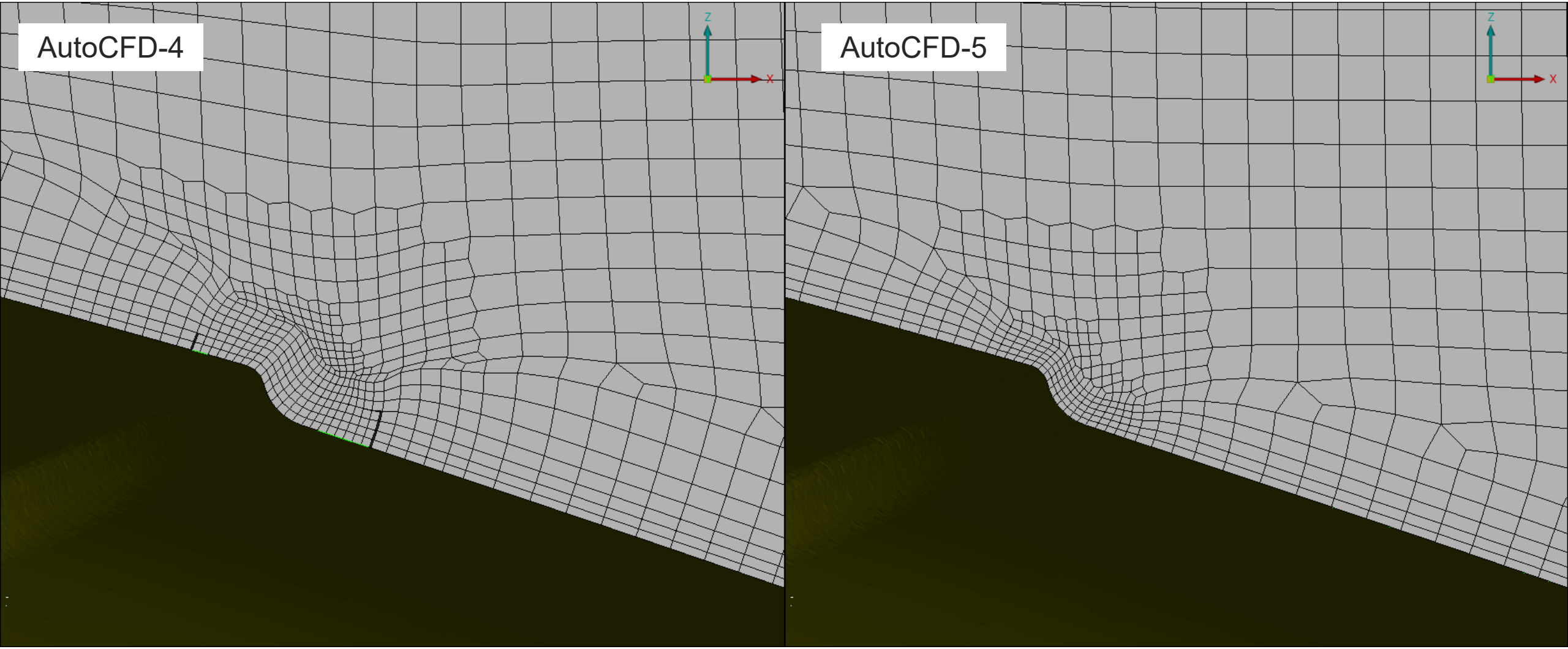
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Volume mesh – reduction of N layers from 7 to 5



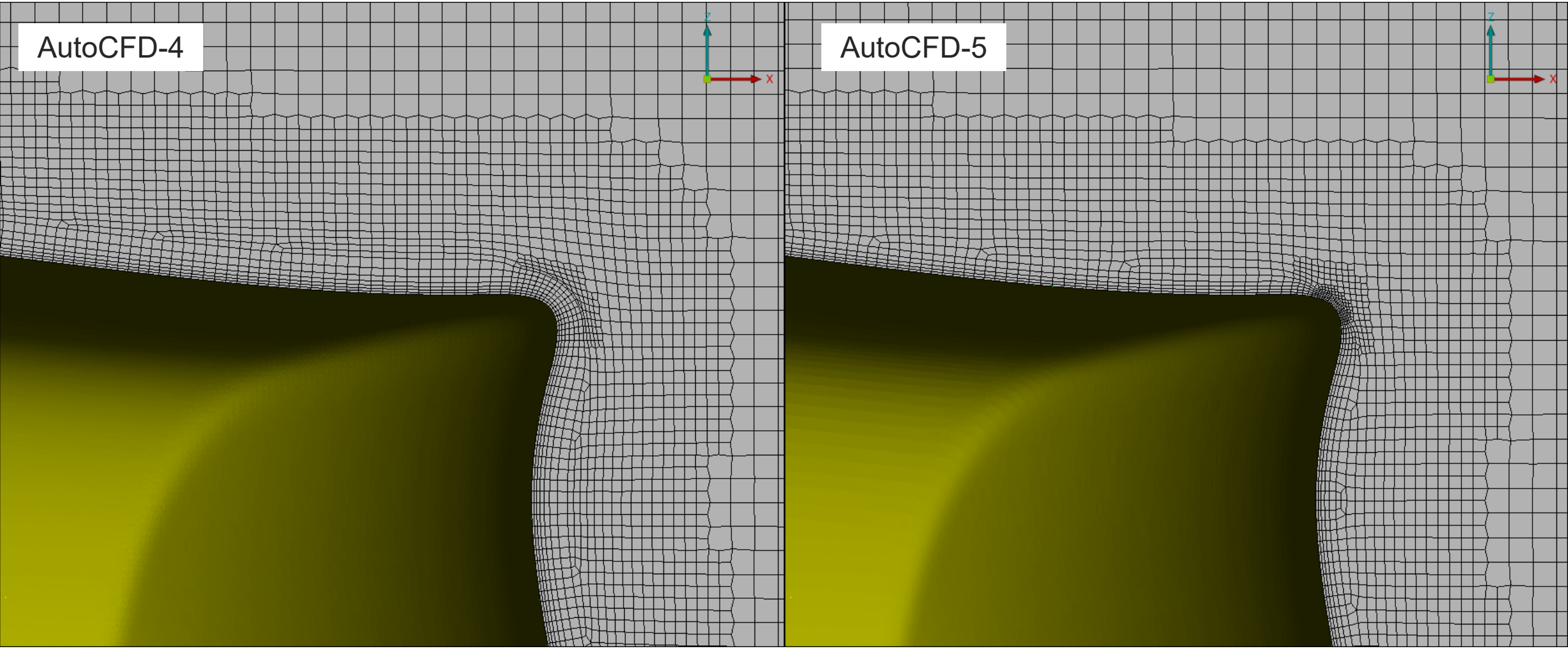
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Volume mesh – reduction of N layers from 7 to 5



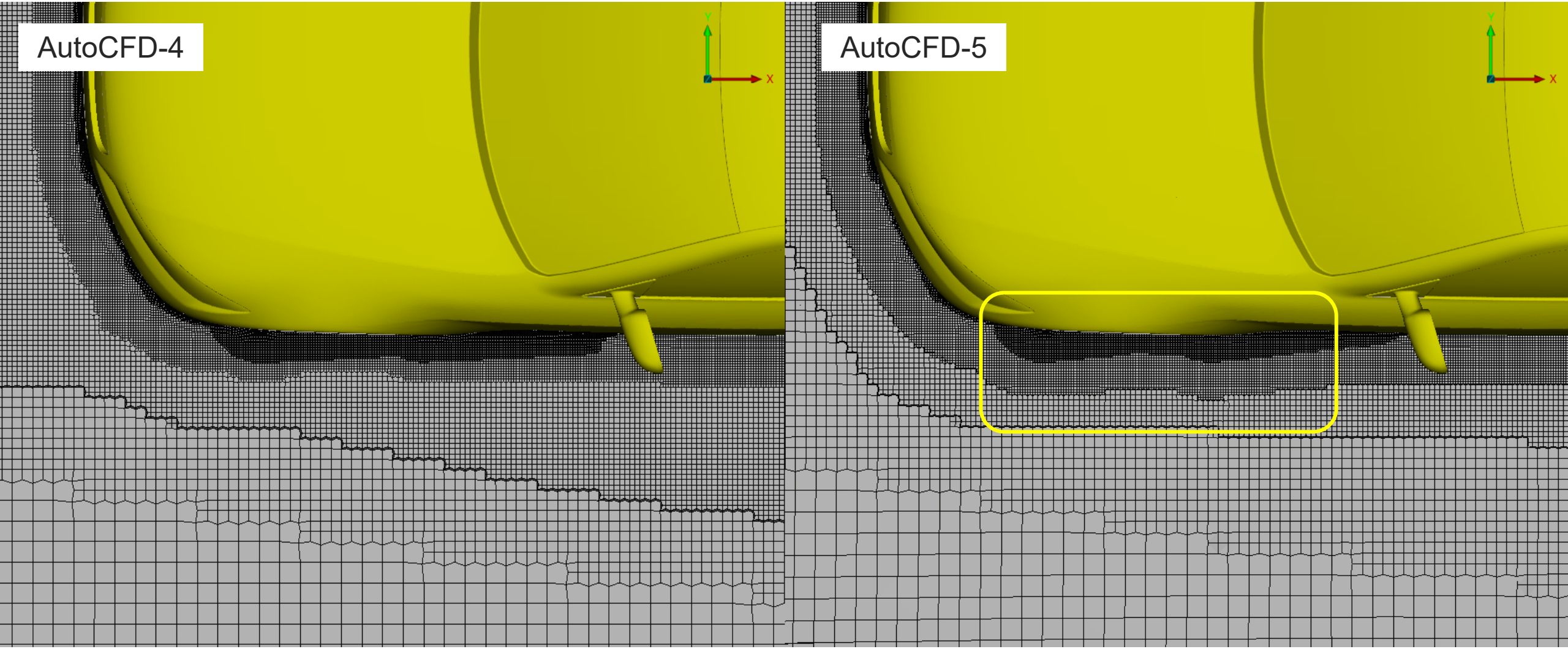
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Volume mesh –finer curvature refinement



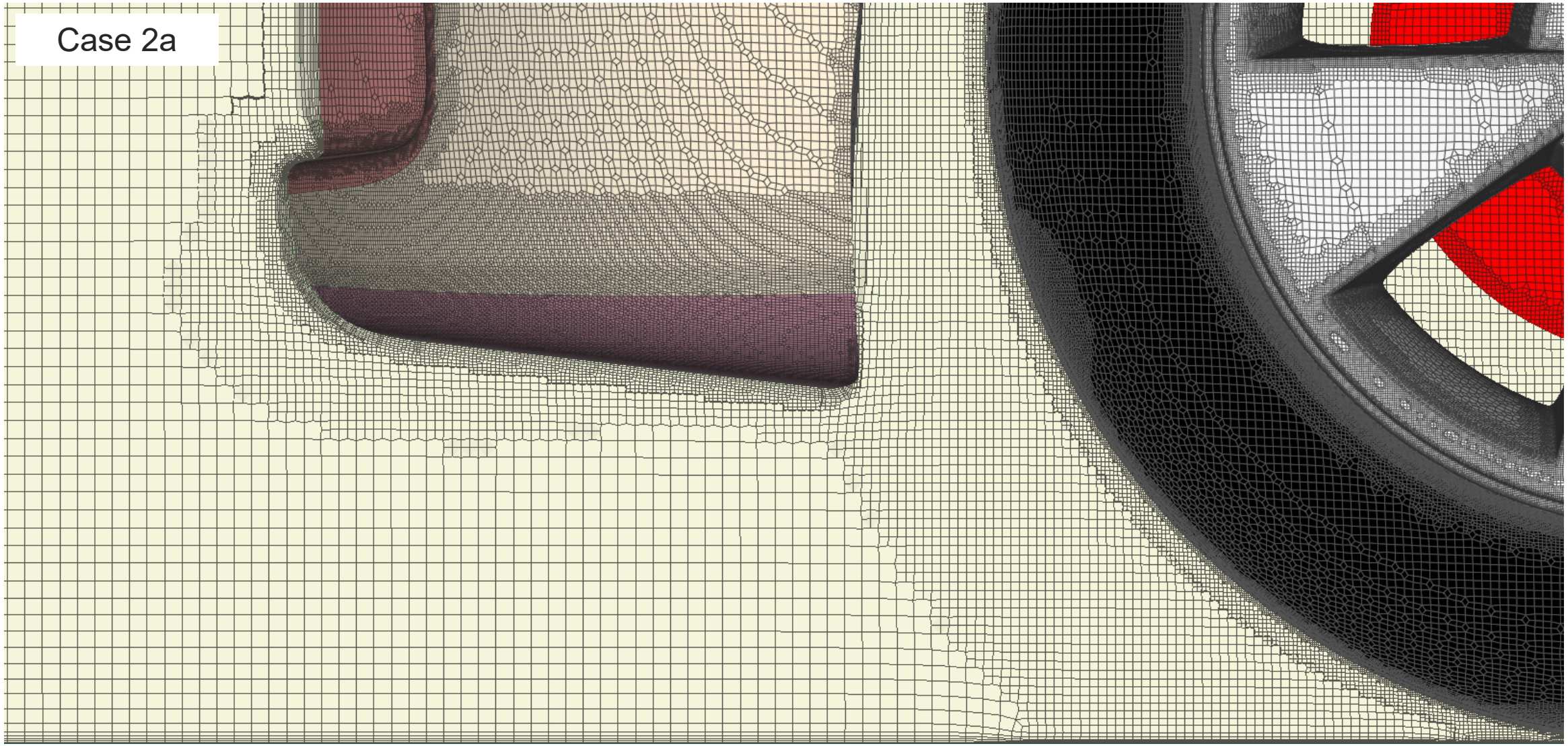
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Volume mesh – widening of refinement near front wheel



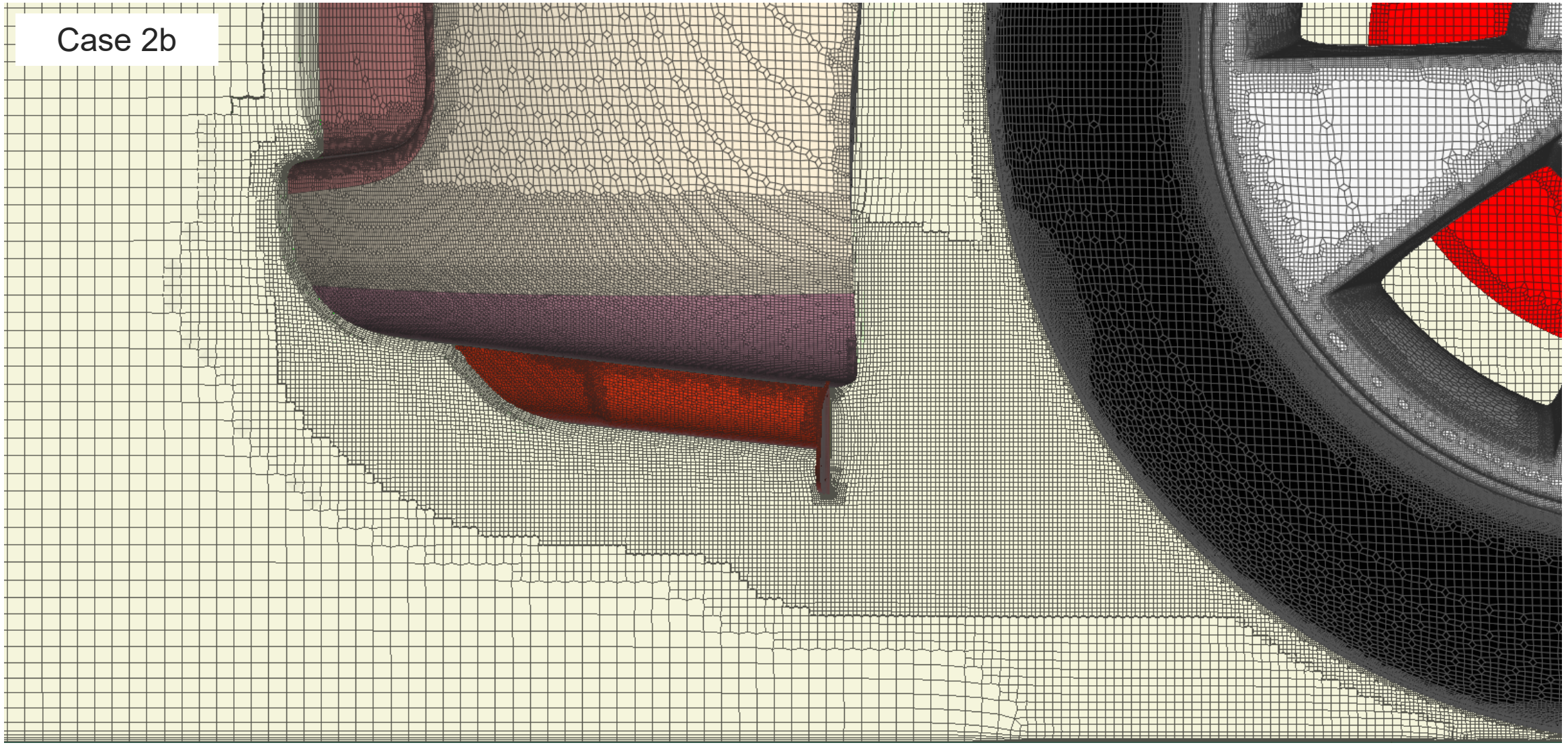
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Volume mesh – consistency between variants



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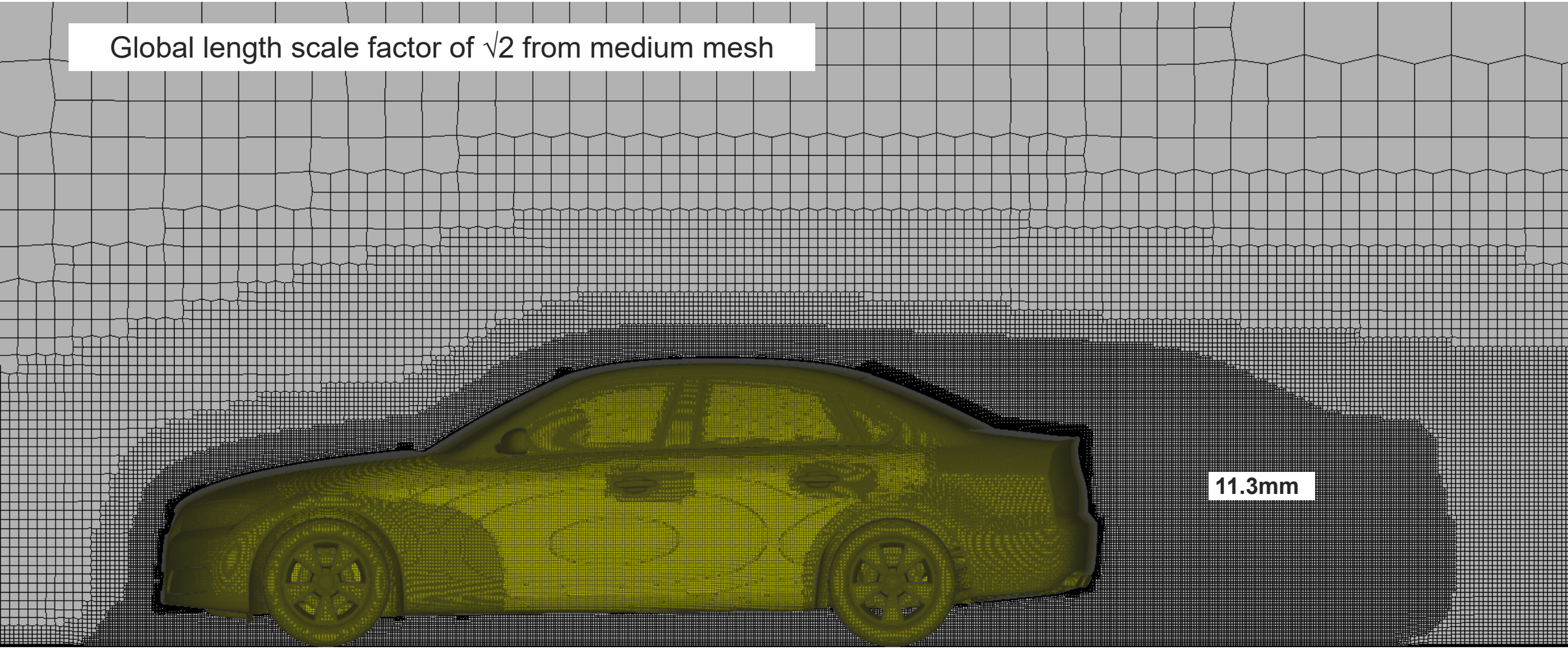
Volume mesh – consistency between variants



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Mesh Refinement study – Coarse – 66 million cells

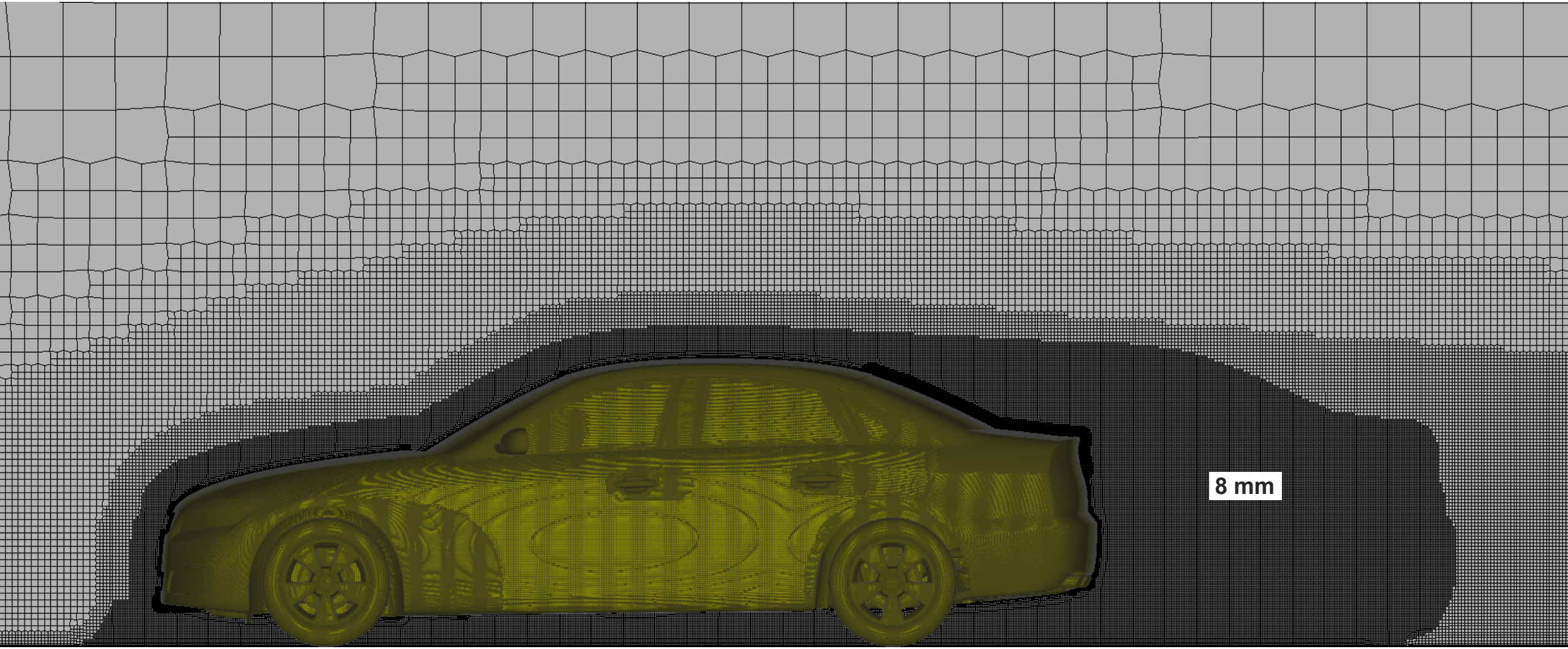
Global length scale factor of $\sqrt{2}$ from medium mesh



Layers specifications remain the same as for Medium size mesh

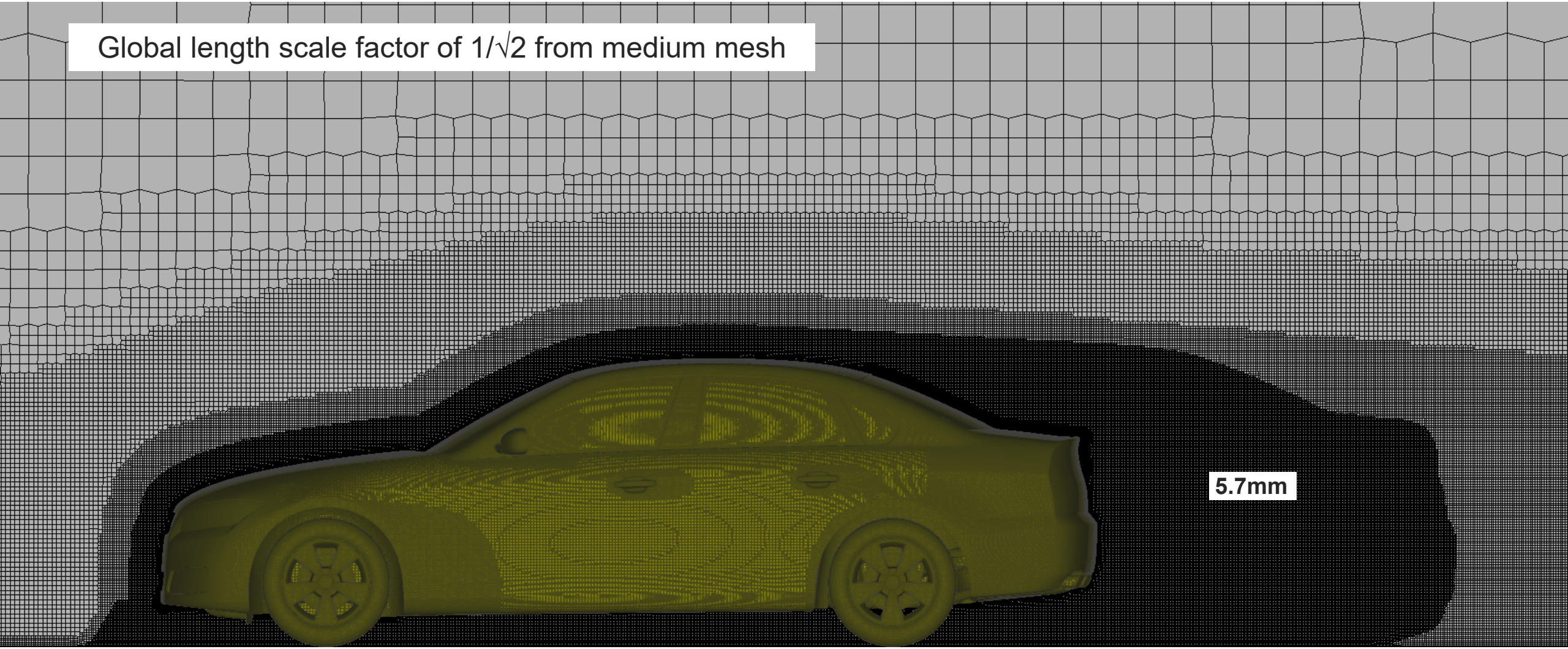
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Mesh Refinement study – Medium – 123 million cells



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Mesh Refinement study – Fine – 260 million cells



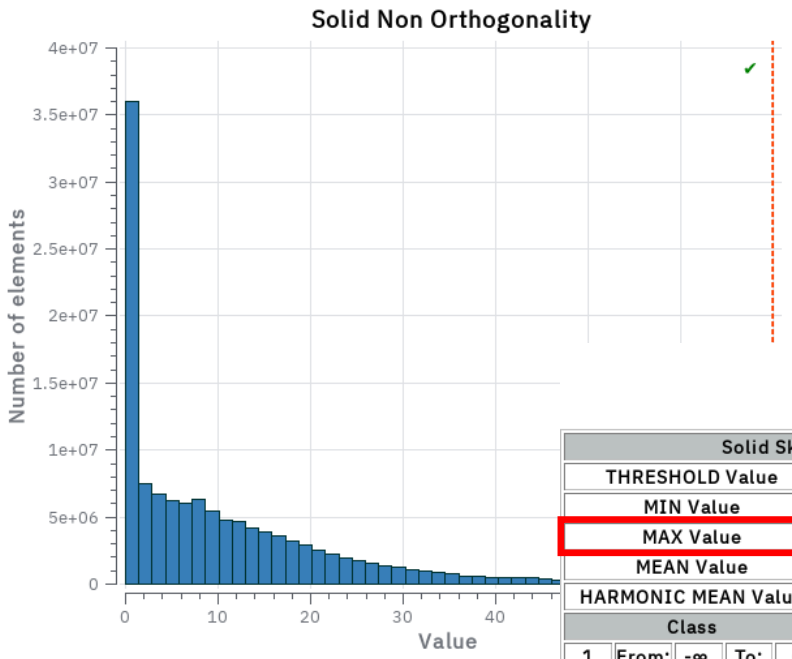
Layers specifications remain the same as for Medium size mesh

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Quality criteria check for multiple CFD solvers

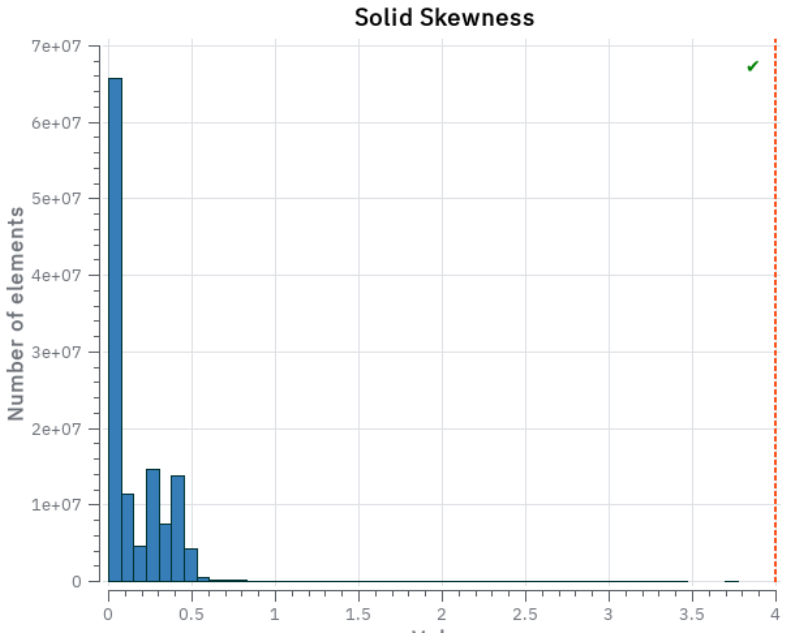
Solid Non Orthogonality (NON ORTHOGONALITY [OPENFOAM])

Solid Non Orthogonality Table						
THRESHOLD Value					70	
MIN Value					0	
MAX Value					69.9999	
MEAN Value					10.6103	
HARMONIC MEAN Value					0.00020579	
Class					No of Elements	Perc(%)
1	From:	-∞	To:	0	0	0
2	From:	0	To:	10	73953475	59.9149
3	From:	10	To:	20	27181589	22.0217
4	From:	20	To:	30	12652696	10.2508
5	From:	30	To:	40	5396809	4.37234
6	From:	40	To:	50	2760019	2.23609
7	From:	50	To:	60	1158892	0.9389
8	From:	60	To:	70	327318	0.265183
9	From:	70	To:	80	0	0
10	From:	80	To:	90	0	0
11	From:	90	To:	180	0	0
12	From:	180	To:	+∞	0	0
Out of any class range					0	0
TOTAL					123430798	



Solid Skewness (SKEW FACTOR [OPENFOAM])

Solid Skewness Table						
THRESHOLD Value					4	
MIN Value					0	
MAX Value					3.77503	
MEAN Value					0.151322	
HARMONIC MEAN Value					1.95257e-19	
Class					No of Elements	Perc(%)
1	From:	-∞	To:	0	0	0
2	From:	0	To:	1	122920808	99.5868
3	From:	1	To:	2	479183	0.38822
4	From:	2	To:	3	30745	0.0249087
5	From:	3	To:	4	62	5.02306e-05
6	From:	4	To:	5	0	0
7	From:	5	To:	6	0	0
8	From:	6	To:	7	0	0
9	From:	7	To:	8	0	0
10	From:	8	To:	9	0	0
11	From:	9	To:	10	0	0
12	From:	10	To:	12	0	0
13	From:	12	To:	14	0	0
14	From:	14	To:	16	0	0



Mesh quality was also checked
for other CFD solvers, like
Fidelity Flow, Fluent, CFD++ and more

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Concluding remarks and looking ahead

- Redistribution of refinement zones aimed at:
  - Further refinement of surface curvatures
  - Further refinement of important flow regions
  - Coarsening of unnecessarily refined areas
  - Use of fewer Size Boxes and rely more on Surface Offset and Sweep rules

- Reduction of total number of layers from 7 to 5

- Overall ~22% reduction in cell count from AutoCFD4 meshes

- Better quality criteria for more CFD solvers

- Looking forward to your feedback

- As a TFG we did not manage to make more studies due to constraints (limited resources, no platform to share and exchange meshes etc)

- The Meshing TFG may have made its circle and in the future meshing related tasks could be integrated in the SRS TFG as a sub-task

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