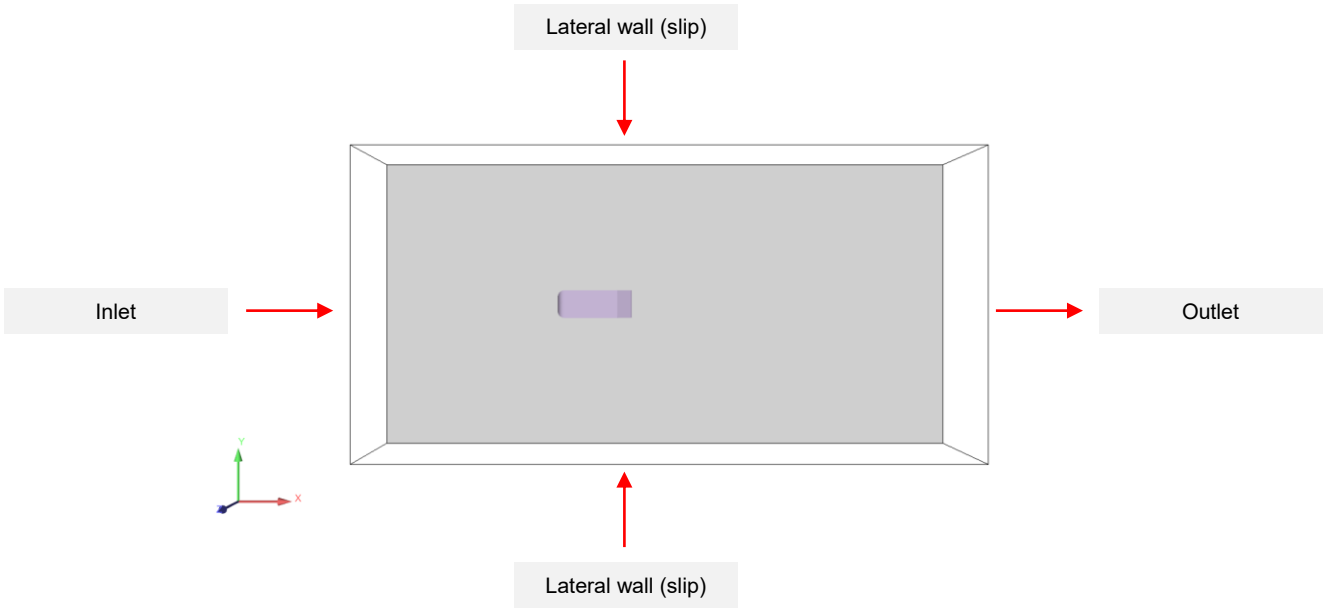
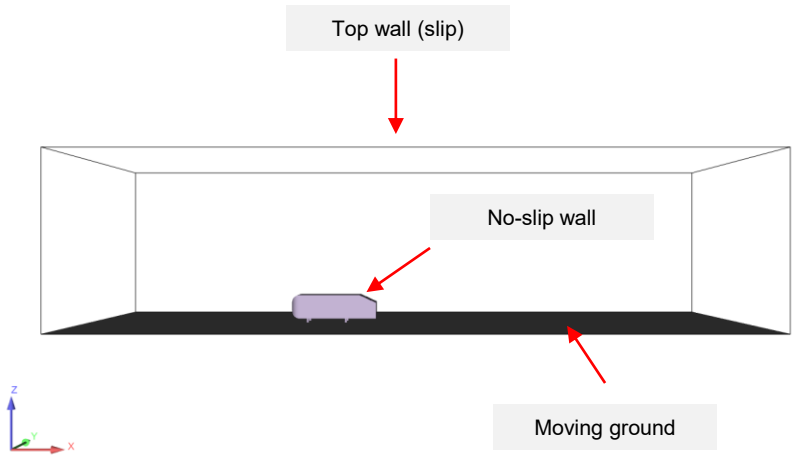
Problem definition

Ahmed body

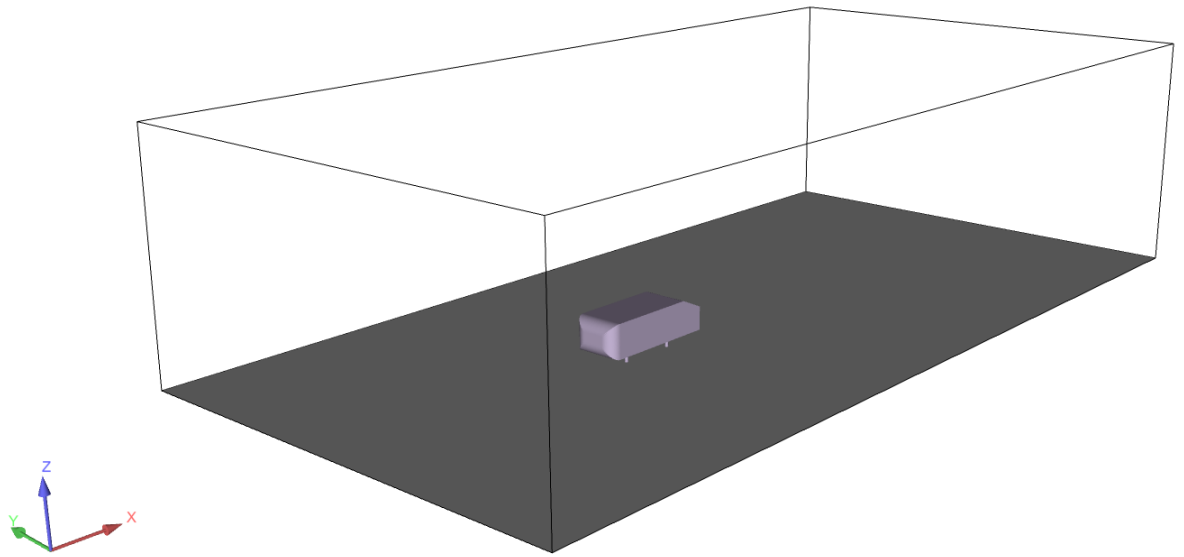




- This a validation case of the automotive industry.
- However, we will run the simulation as a demonstration case.
- At this point, it is up to you to setup the case and compute the drag coefficient.

Problem definition

Ahmed body



- Working fluid: air, incompressible, isothermal, default properties.
- Inlet velocity: 40 m/s
- Reference area to compute the force coefficients: 0.11503 m^2 (frontal area)
- Use any turbulence model.
- Do the standard post-processing and identify/compute: vortical structures, integral length scales, ratio of integral length scale to grid length scale, cut-planes with velocity contours, oil lines, separation points, and so on.
- Assess the goodness of the mesh.
- Sample at any location on the body surface (preferably where the flow attached) and plot the normalized velocity profile.
- Run in steady and unsteady mode and compute the flow statistics.

Problem definition

Ahmed body

Quantity of interest	Minimum c_d	Maximum c_d
Drag coefficient	0.26	0.38

- There is plenty of validation data for this case.
- However, we are not interested in conducting an exhaustive validation.
- Therefore, we are given you a lot of margin of error.
- I only want to check if you are able to setup a case from scratch.
- The computed drag coefficient should be contained within the indicated error band.
- You can use the mesh provided
- By the way, I do not recall if it is wall resolving or wall modeling, that is up to you to find out.
- You also have the geometry, so you can do your own mesh.

Problem definition

Ahmed body

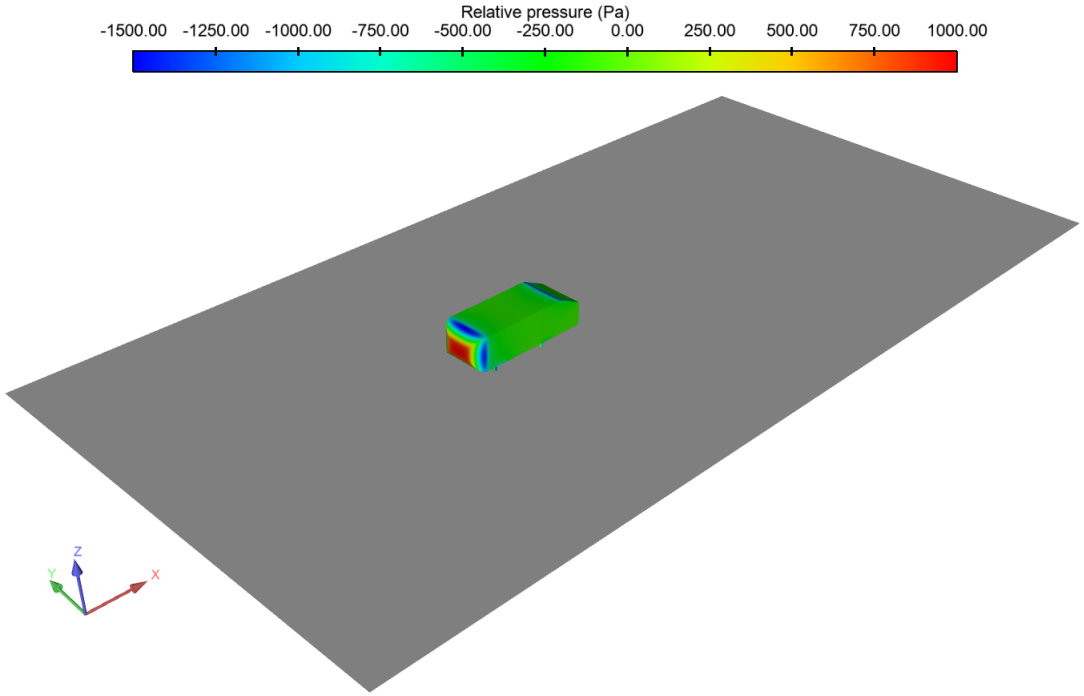
- **A few references:**
  - Working fluid: air, incompressible, isothermal, default properties.
  - S.R. Ahmed, G. Ramm. Some Salient Features of the Time-Averaged Ground Vehicle Wake. SAE-Paper 840300, 1984.
  - H. Lienhart, S. Becker. Flow and Turbulence Structure in the Wake of a Simplified Car Model. SAE 2003 World Congress, SAE Paper 2003-01-0656, Detroit, Michigan, USA, 2003.
  - R. Pagliarella, S. Watkins, A. Tempia. Aerodynamic Performance of Vehicles in Platoons: The Influence of Backlight Angles. SAE Technical Paper 2007-01-1547, 2007.
  - On the Aerodynamic Performance of Automotive Vehicle Platoons Featuring Pre and Post-Critical Leading Forms. R. Pagliarella, PhD Thesis. RMIT University.
  - http://cfd.mace.manchester.ac.uk/ercoftac/doku.php?id=cases:case082&s[]=ahmed
  - http://www.wolfdynamics.com/tutorials.html?id=146
  - http://www.wolfdynamics.com/tutorials.html?id=147

Problem definition

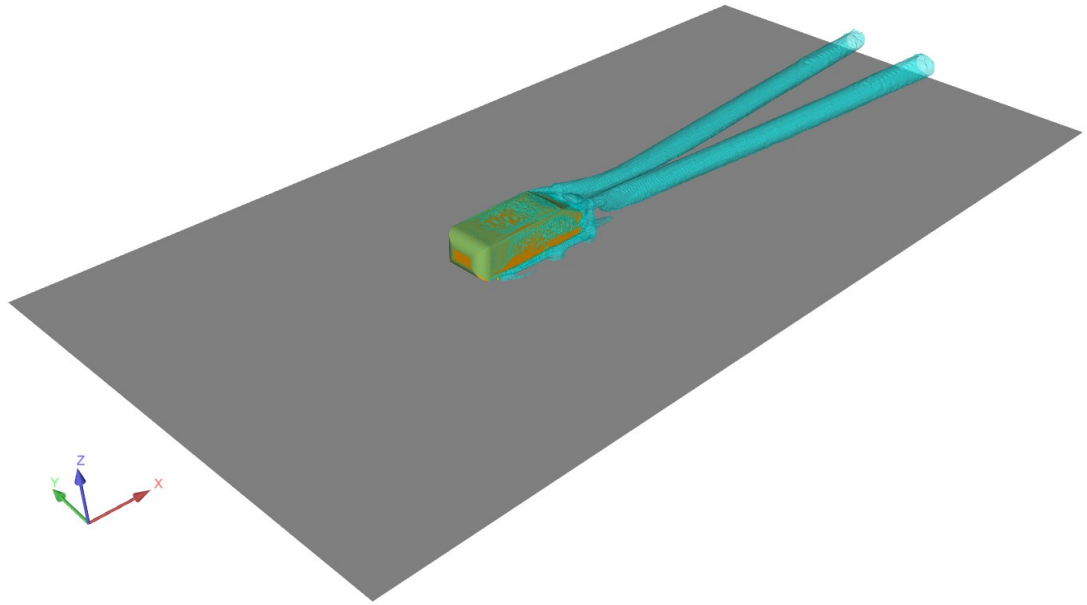
Ahmed body

- Finally, before choosing the turbulence model and potential corrections, look at the geometry and try to answer the following questions:
  - Are there large stagnation points?
  - Are there sharp angles that can generate concentrated vortices?
  - Is there strong system rotation (swirling)?
  - Are there regions that can onset periodic vortex shedding (strong unsteadiness).
  - Do we expect large flow separation?
  - Is there surface roughness?
  - Is the steady hypothesis acceptable?

Qualitative results

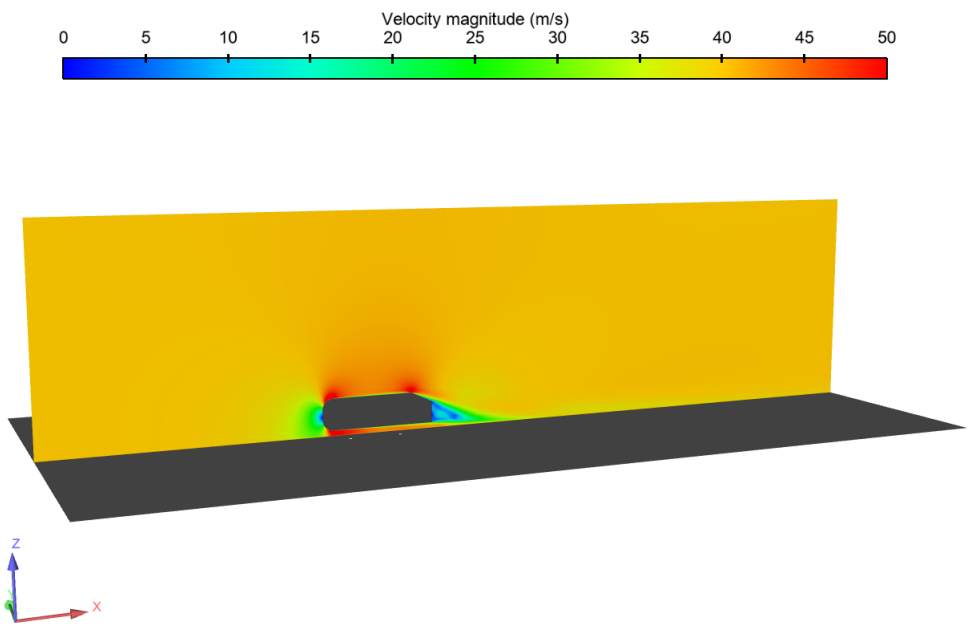


Pressure contours
This figure shows the stagnation points

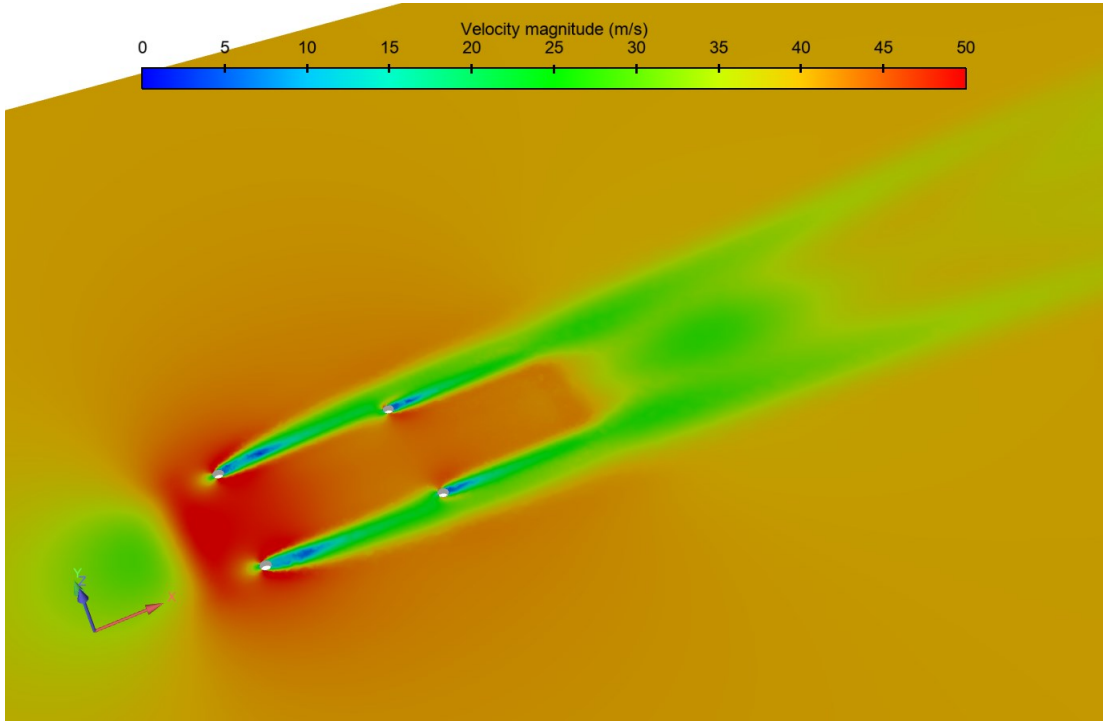


Iso-surfaces of Q-criterion
This figure shows the concentrated vortices

Qualitative results



Velocity contours
This figure shows the presence of wakes.
However, we still need to determine if the wakes are strongly unsteady.



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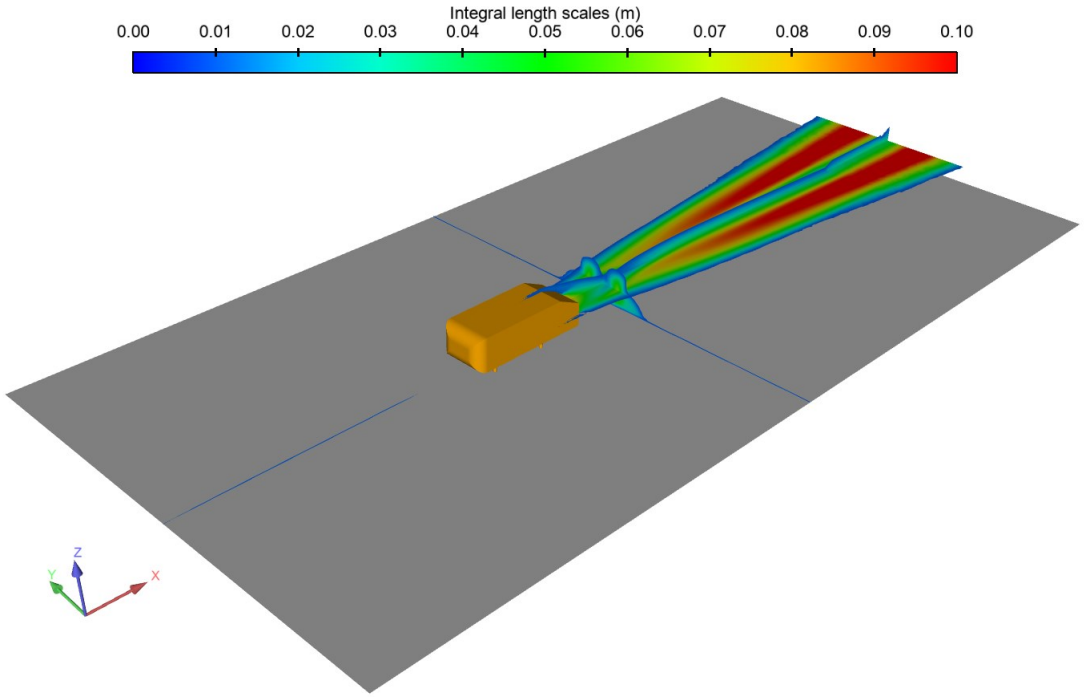
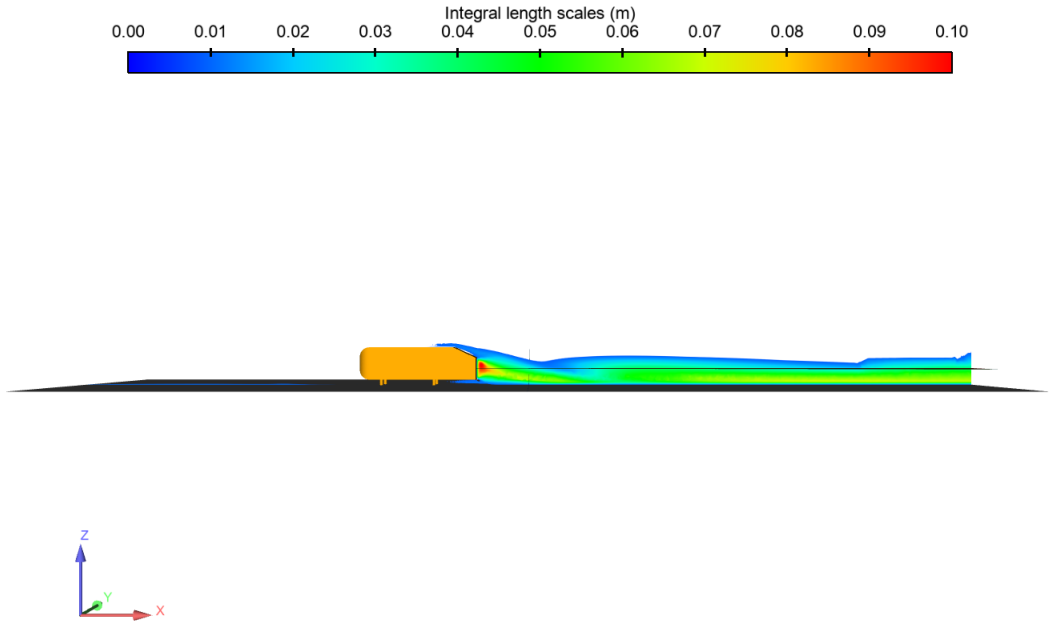


Contours of integral length scales
This figure shows the location of the largest coherent structures



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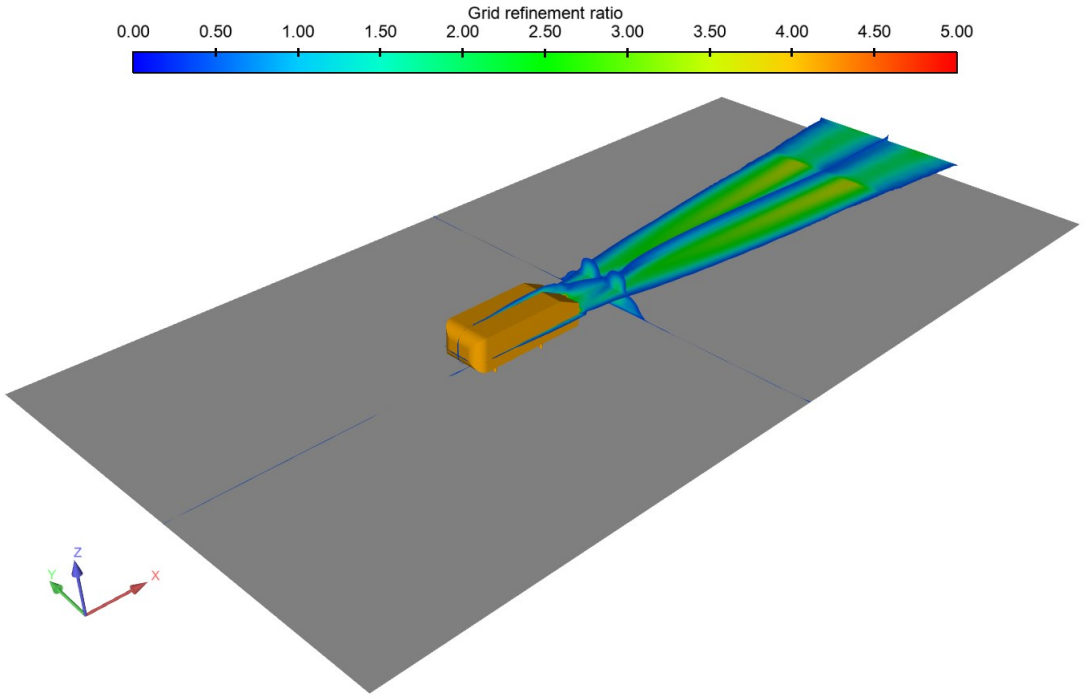
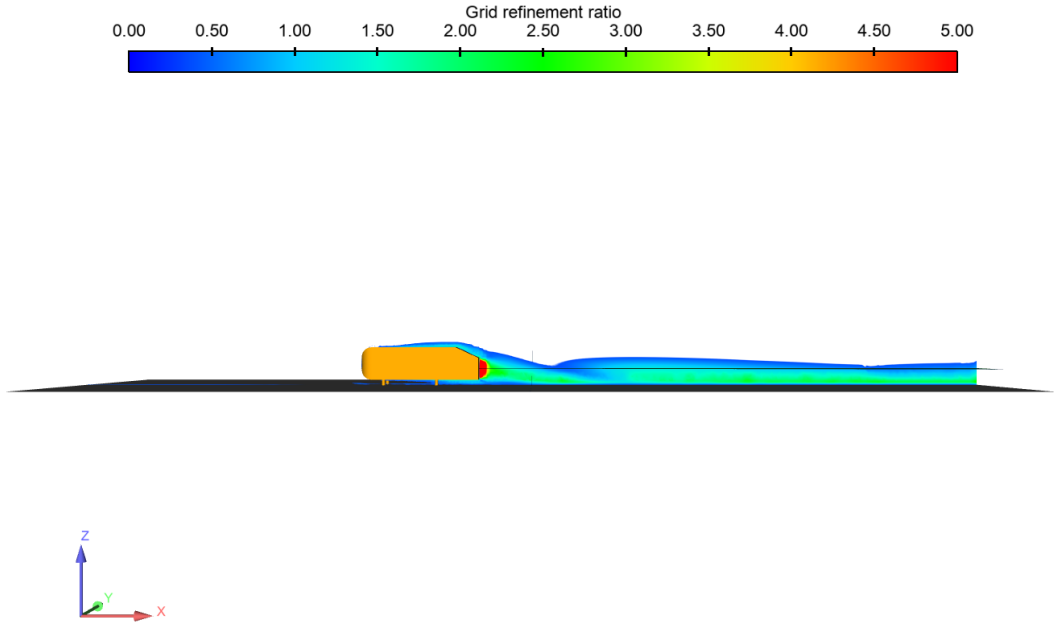


Contours of gird refinement ratio GR
This figure shows the regions where we need to increase cell count according to the grid refinement ratio (GR > 5)



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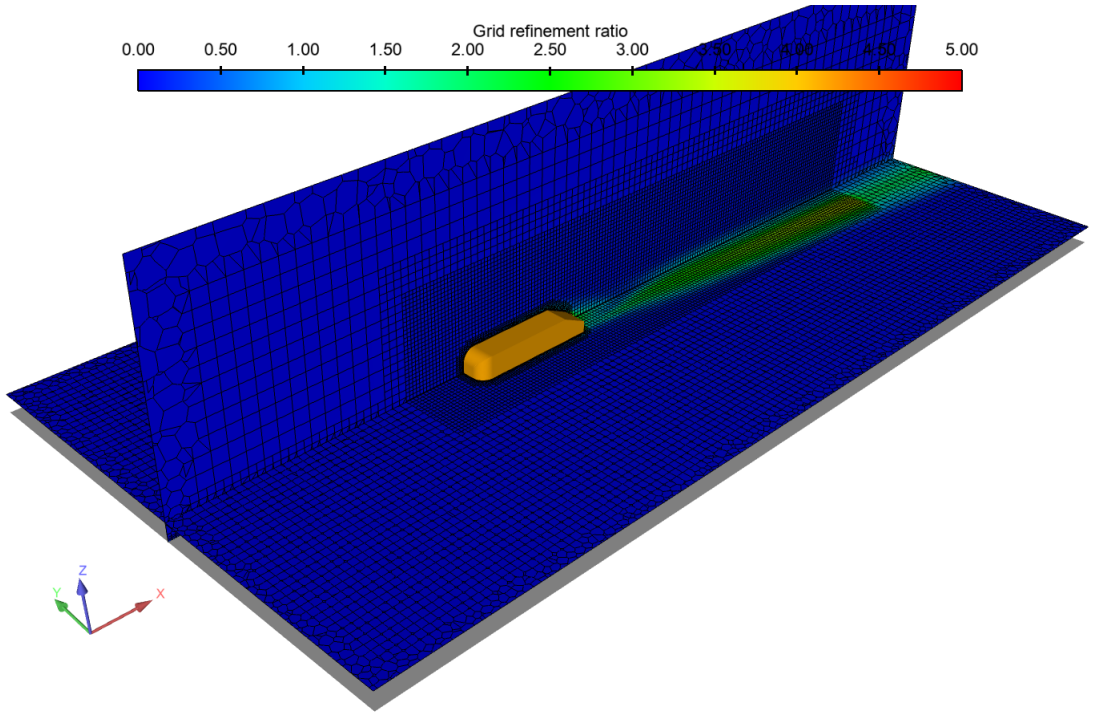
Qualitative results



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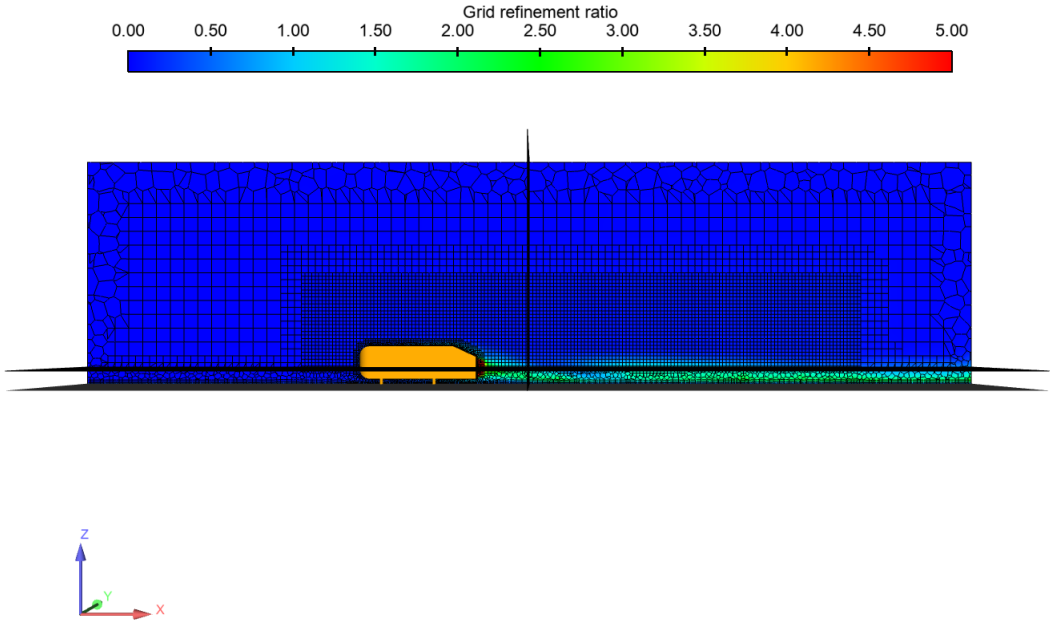

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