COMPUTATIONAL FLUID DYNAMICS

Project: CFD Simulation around pickup truck

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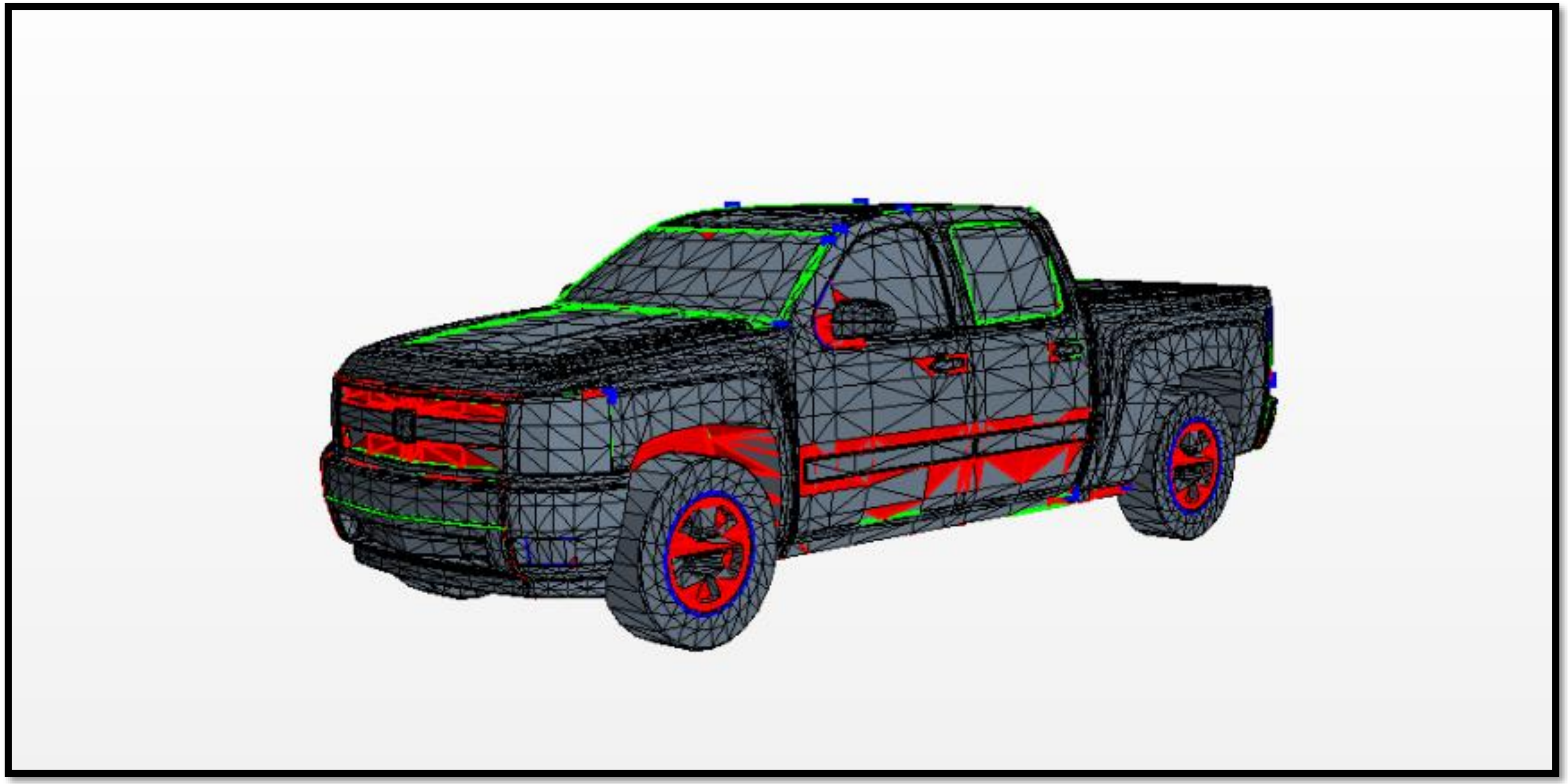
Under the supervision of

Dr. Gabor Janiga

Pickup Truck



Task

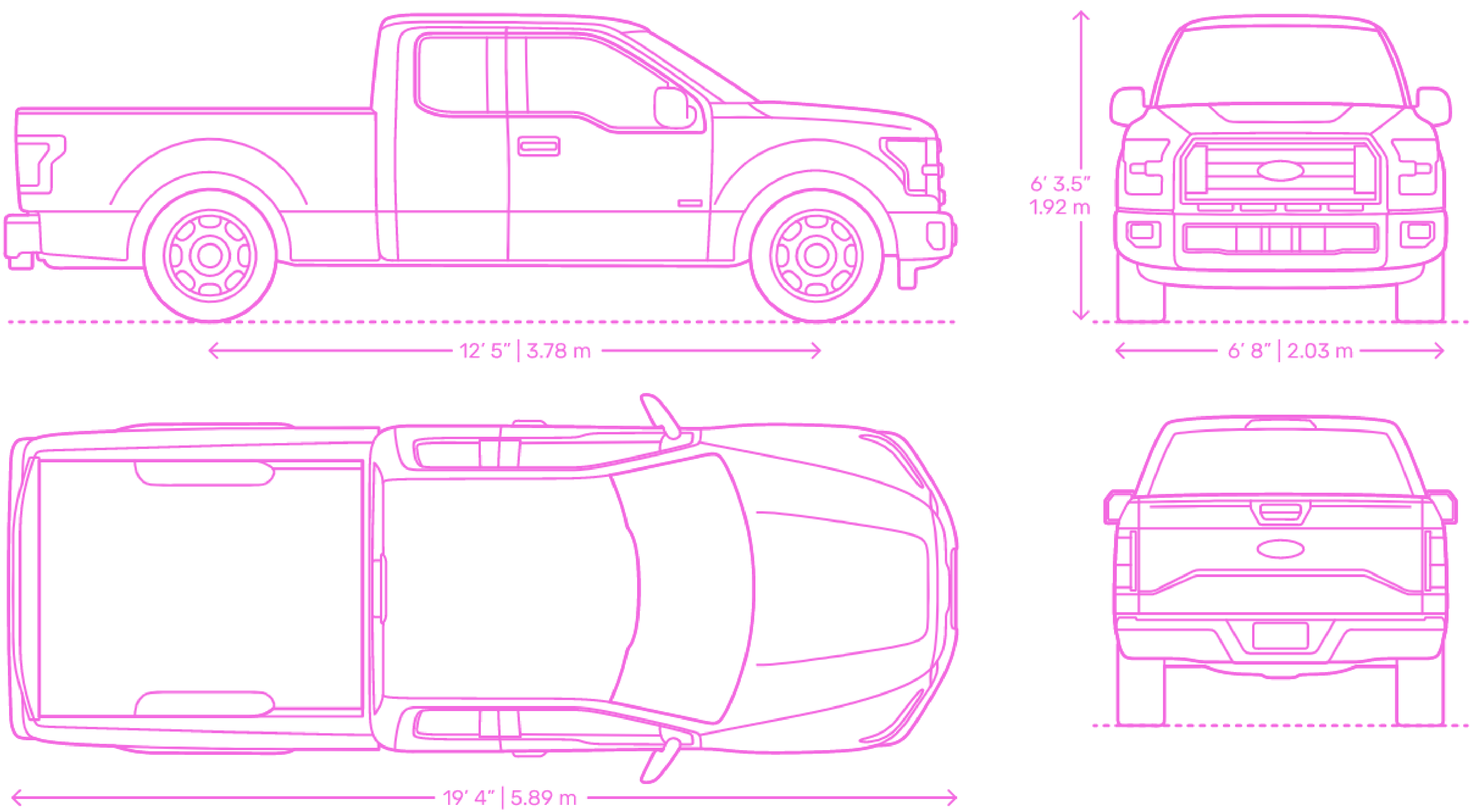
1. Import the provided geometry (adjust the dimension of the geometry if necessary).

2. Create a computational domain with a sufficient size.

3. Generate a computational mesh of sufficient quality and define the boundary conditions.

4. Simulate a steady state three-dimensional flow with inflow-velocities of 75 km/h and 150 km/h.

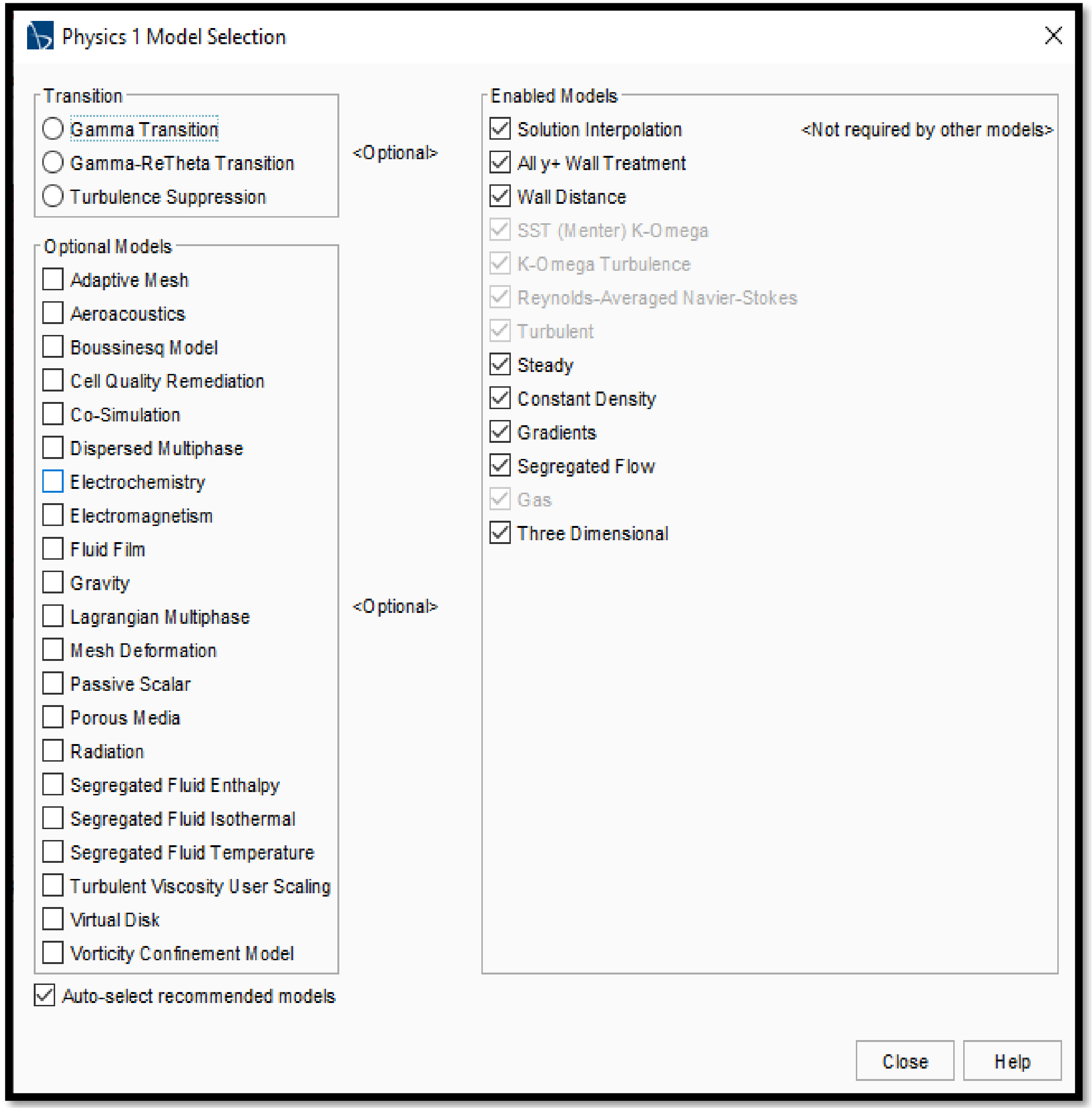
5. Understand and discuss the relevant flow characteristics, such as flow velocity and pressure, drag and lift coefficients such as drag and lift forces.

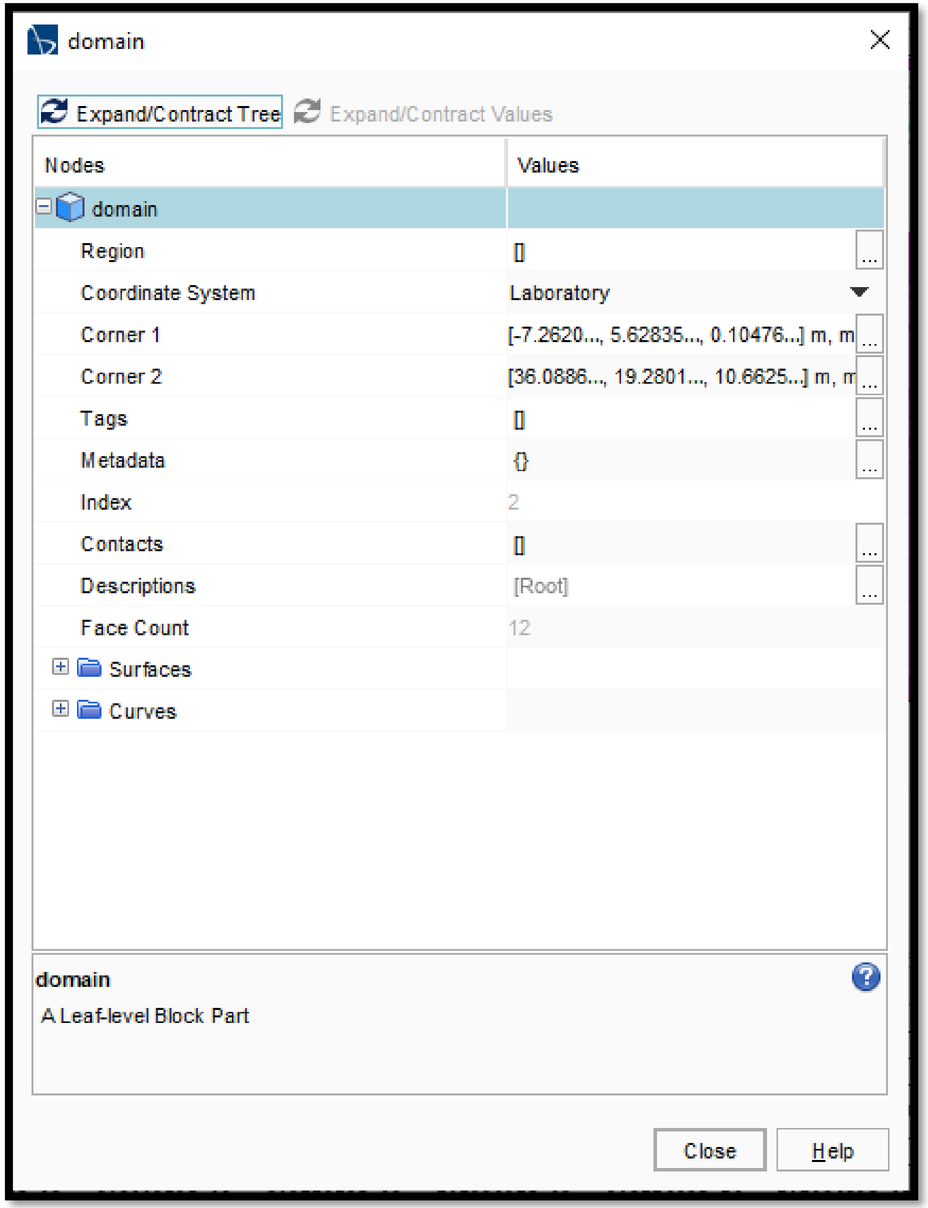


For the truck dimensions I have taken the following reference

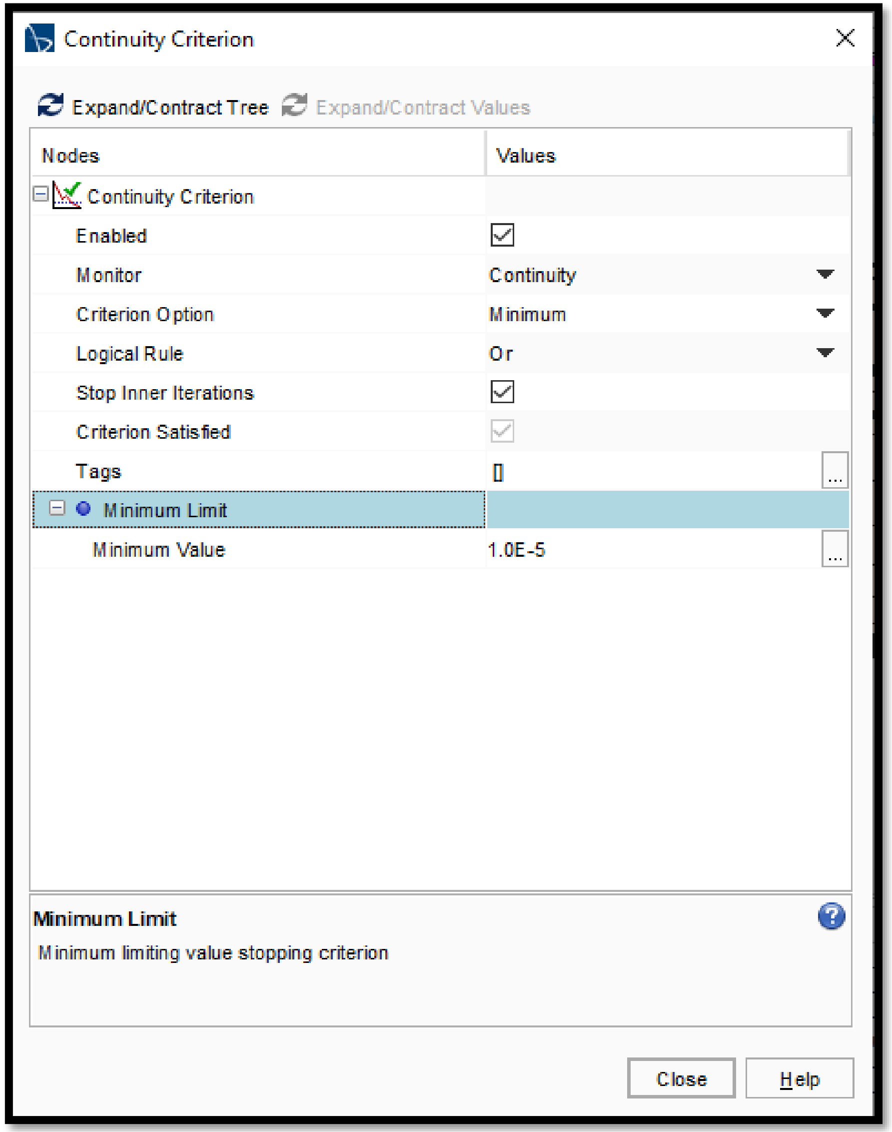
https://www.dimensions.com/collection/pickup-trucks

Domain and Model selection





Continuity Criteria



Model selection:

Steady, Liquid,

Segregated Flow, Gradients,

Constant Density, Turbulent,

Reynolds-Averaged

Navier Stokes, K-Omega

Turbulence, SST (Menter)

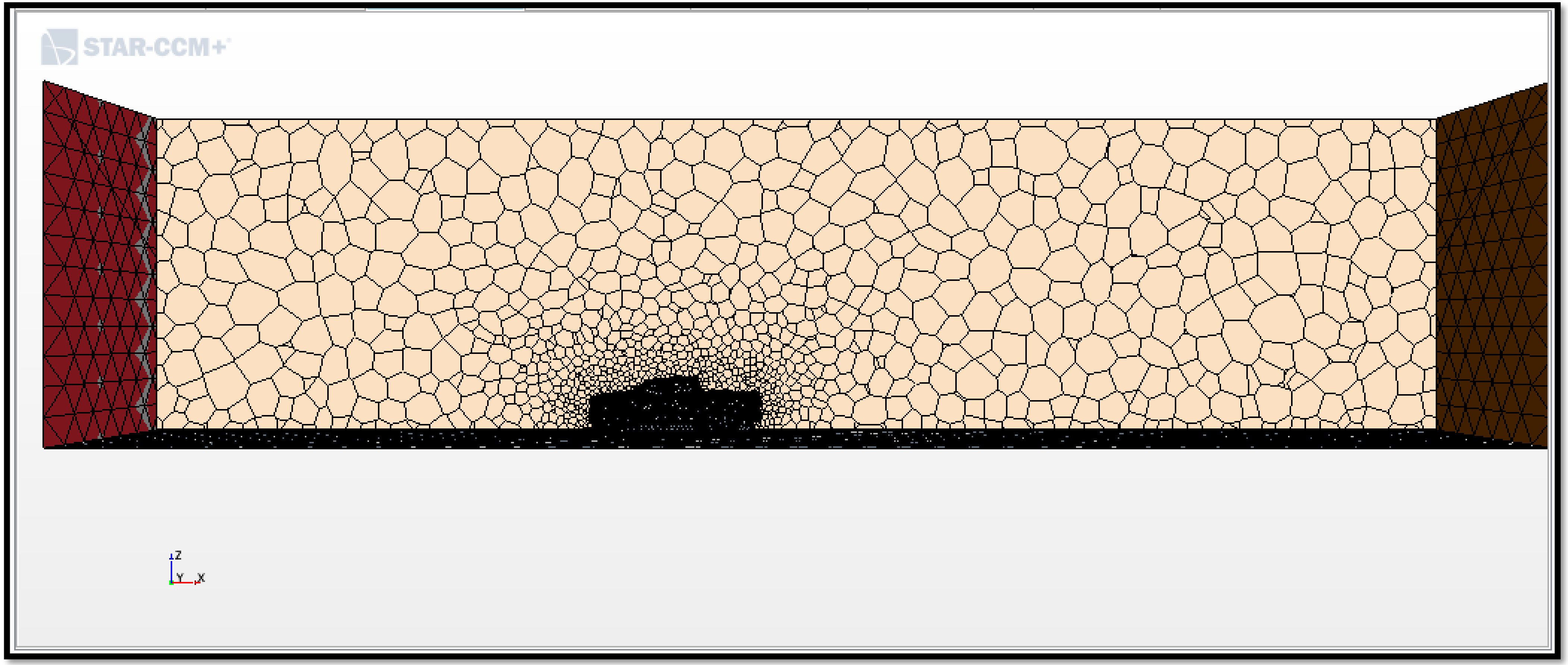
K-Omega,

All y+ Wall Treatment

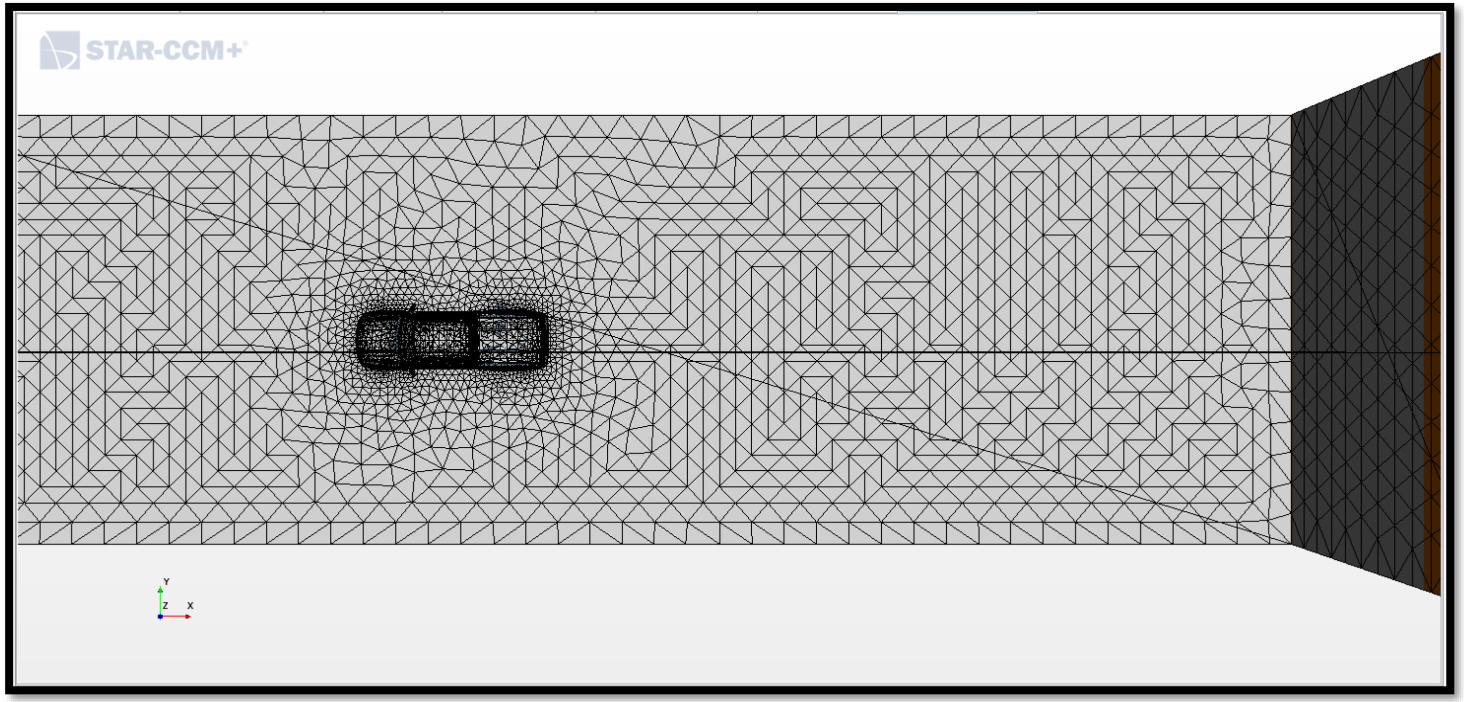
models are enabled.

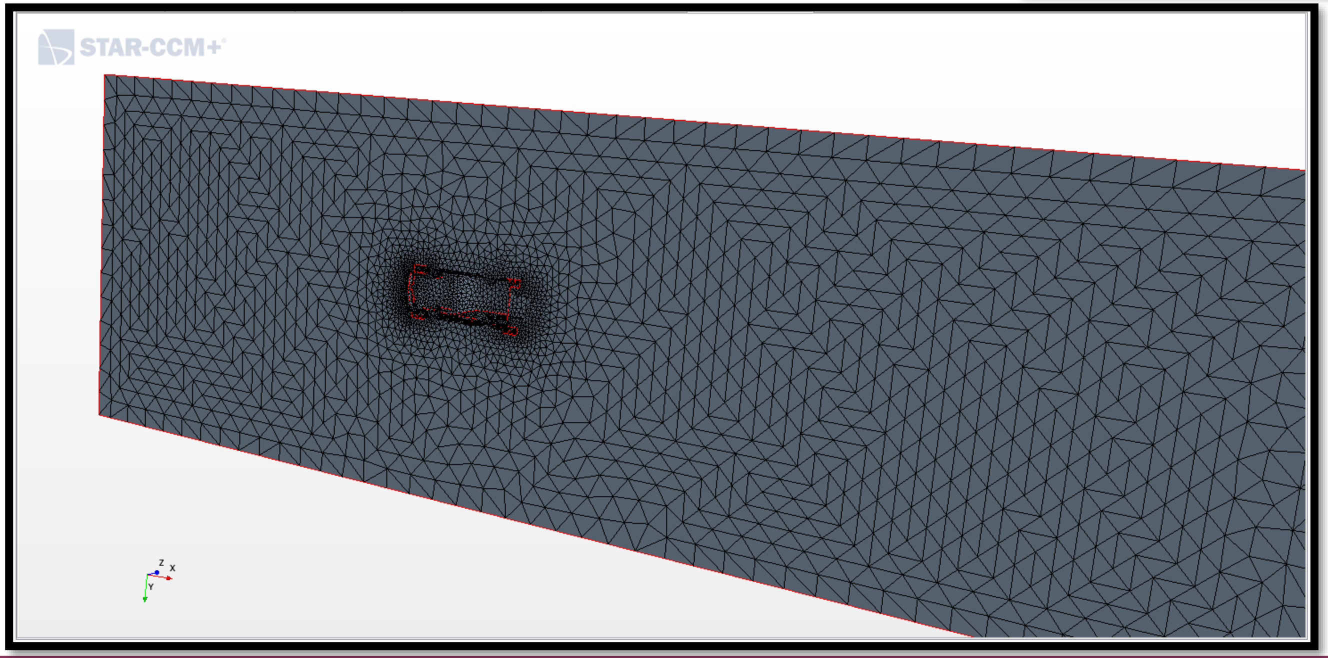
Gas Model is selected.

Geometry and mesh scenes

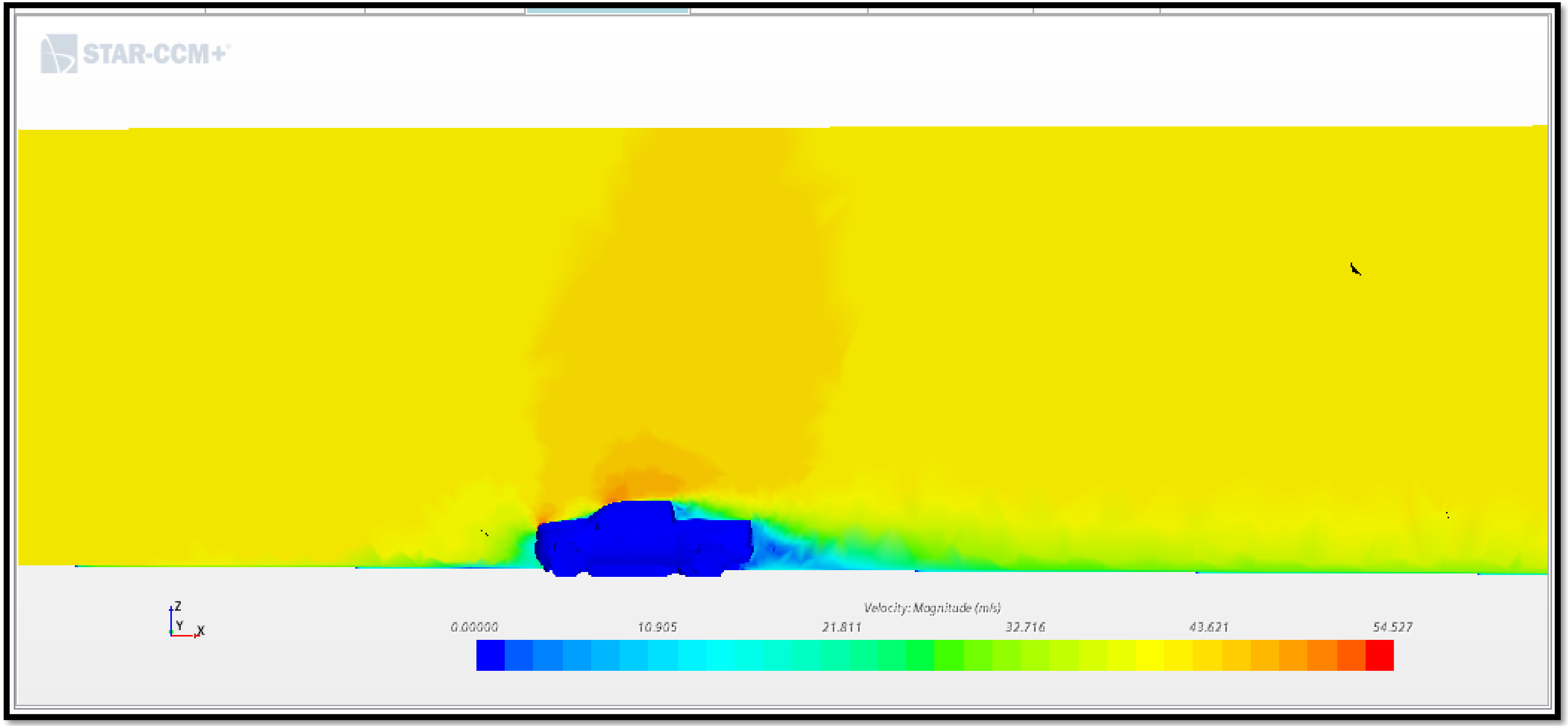


Geometry and mesh scenes



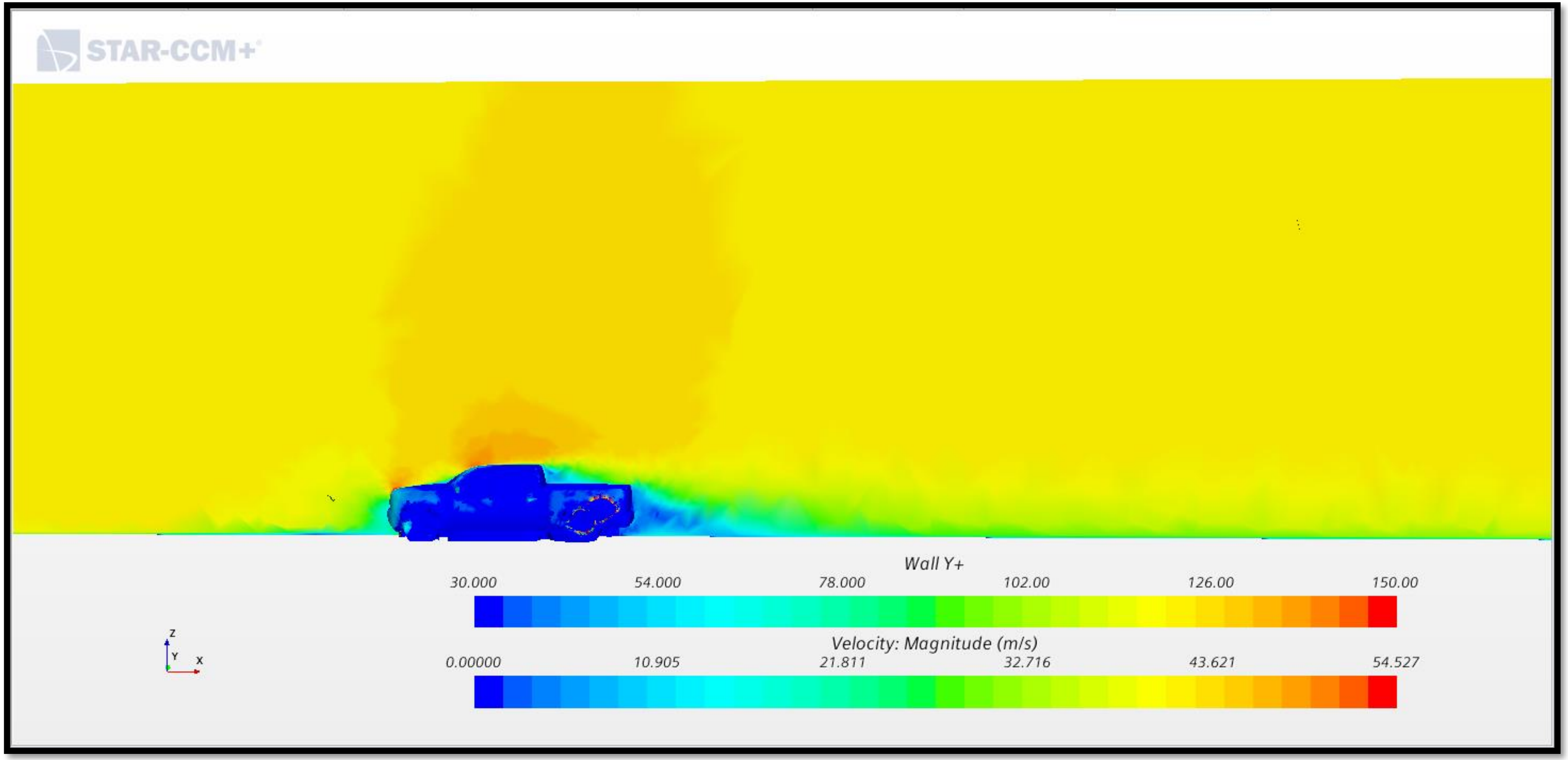


Scalar Scene



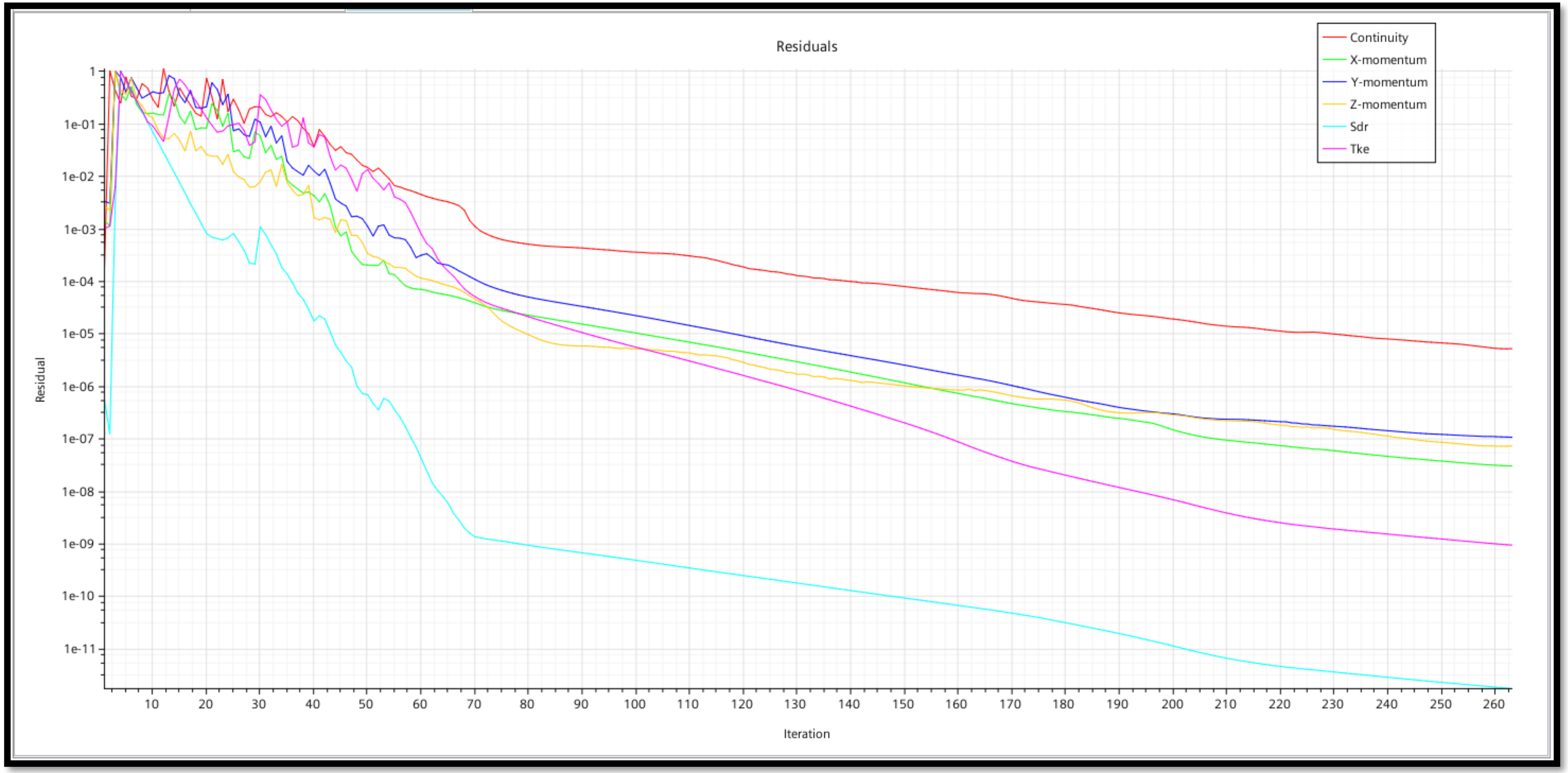
The model was studied for two wind speeds (75 km/h and 150 km/h) that simulate city and highway driving.

Results and discussion

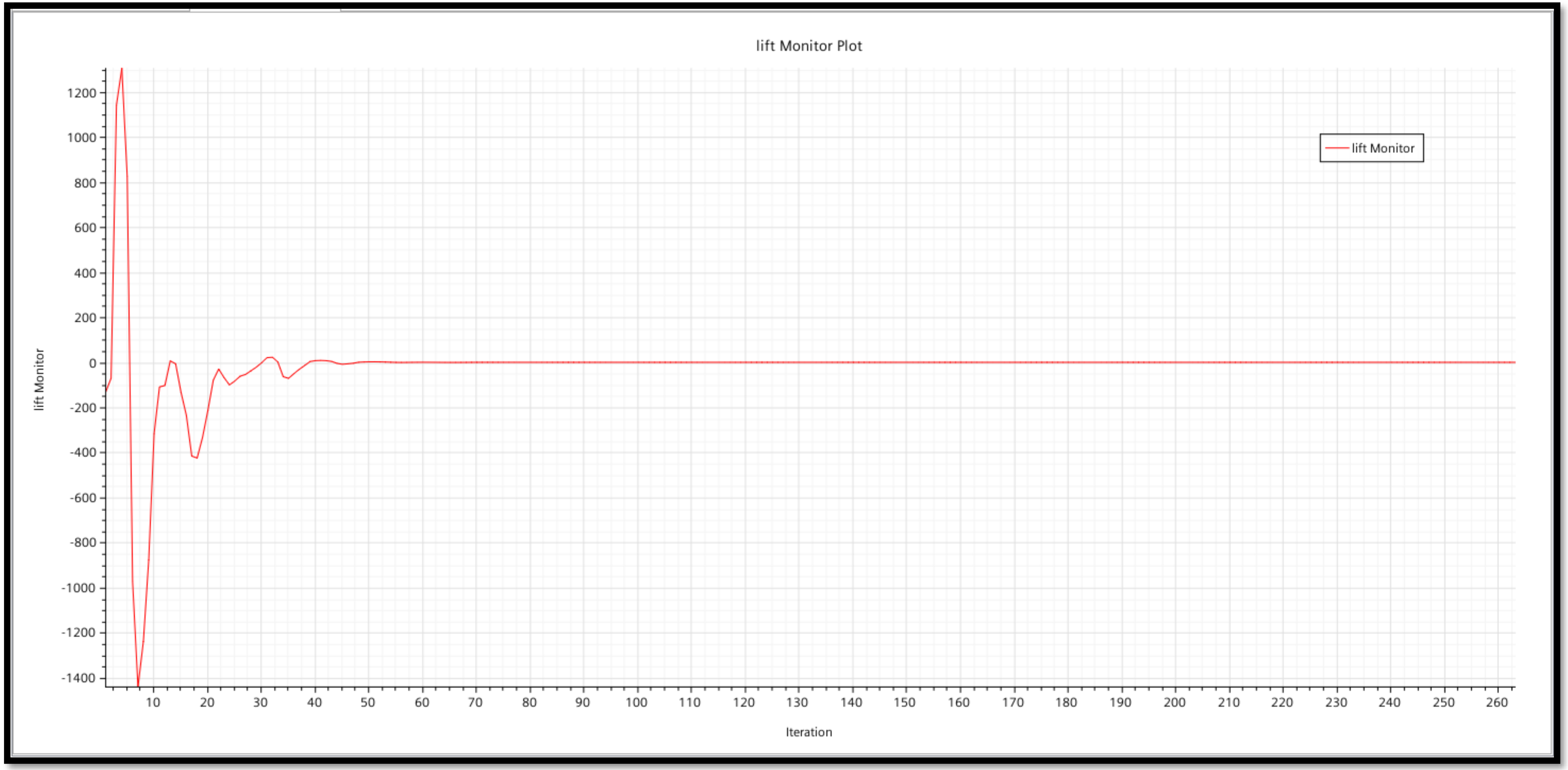


For a maximum velocity – 150 km/h

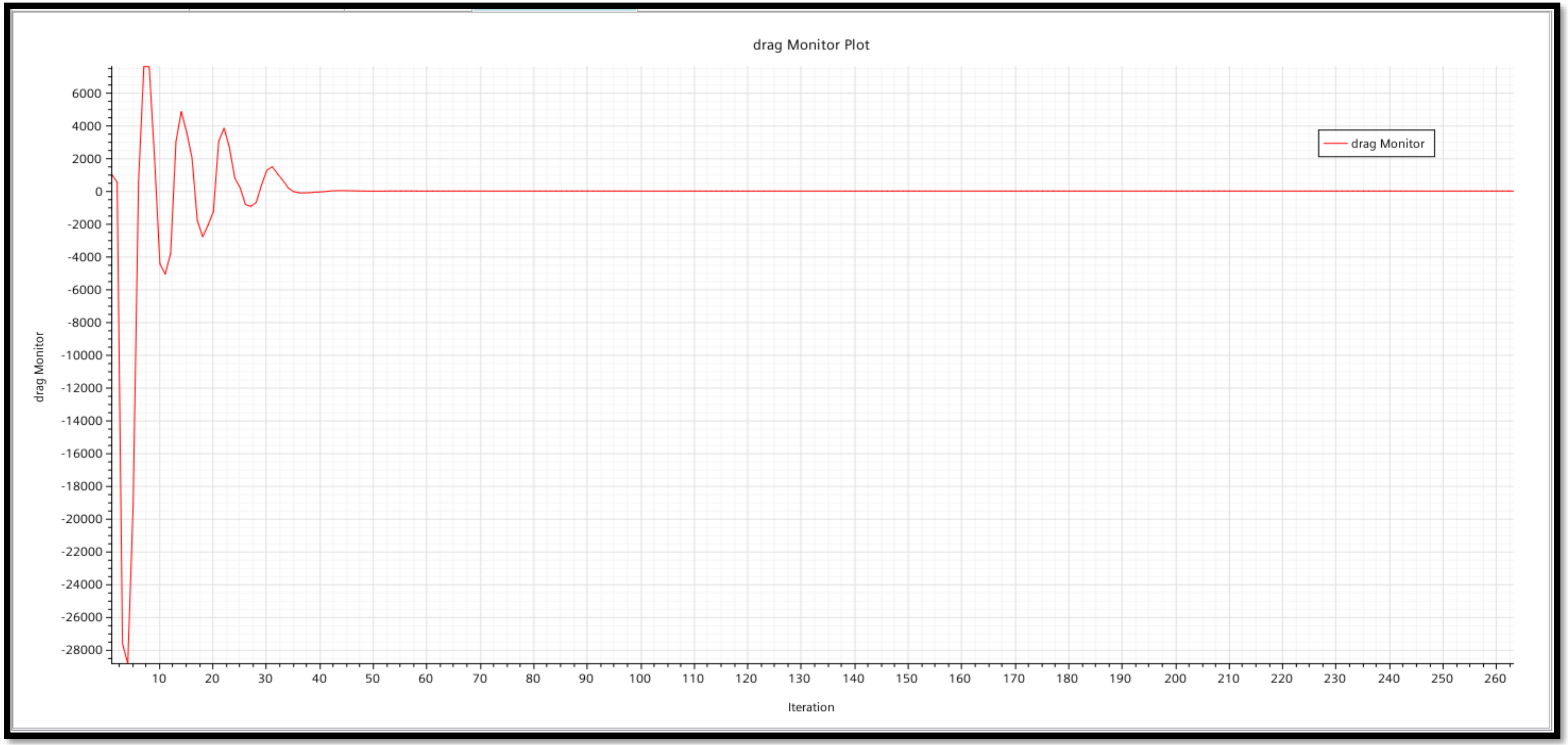
Residuals


Residuals
Continuity
X-momentum
Y-momentum
Z-momentum
Sdr
Tke
1
1e-01
1e-02
1e-03
1e-04
1e-05
1e-06
1e-07
1e-08
1e-09
1e-10
1e-11
Residual
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260
Iteration

Lift monitor plot

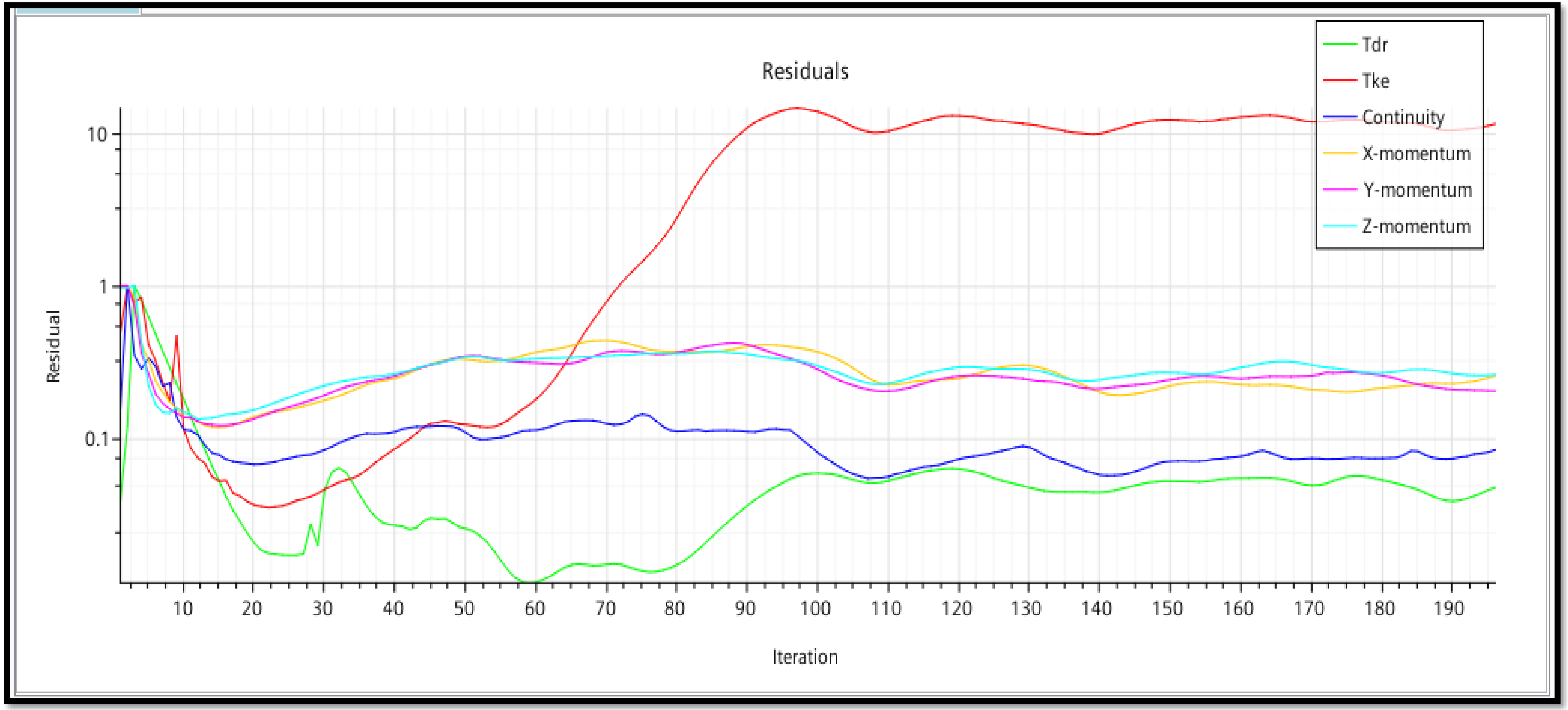


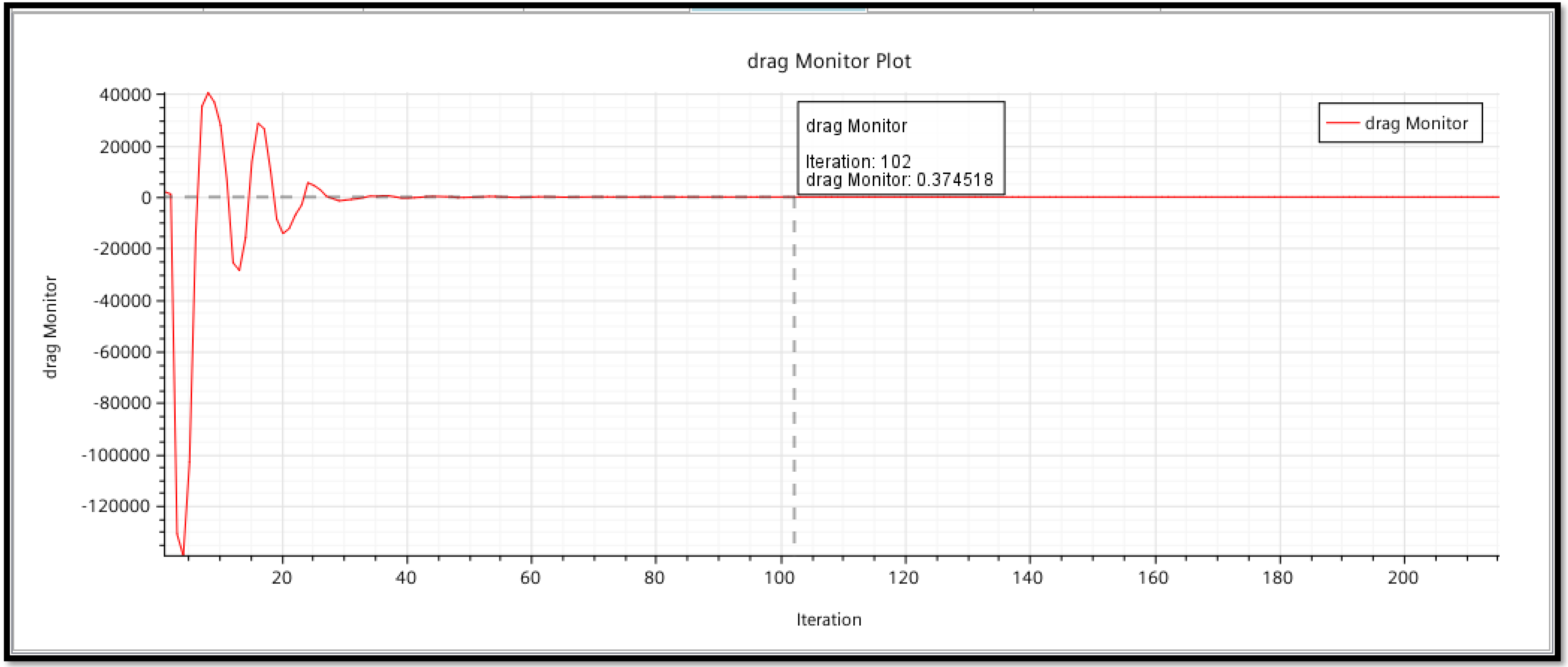
Drag monitor plot



The drag coefficient is computed as $C_D = \frac{F_x}{\frac{1}{2}\rho v^2 A}$

Residuals


Residuals
Tdr
Tke
Continuity
X-momentum
Y-momentum
Z-momentum
Residual
10
1
0.1
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
Iteration



Star 1 ✕ star2 ✕ drag Report ✕

```
Totals:                         [ 1.232677e-01, -7.722705e-05,  1.961014e-01] [ 3.500414e-03,  1.311149e-04,  5.335054e-04] [ 1.267681e-01,  5.388785e-05,  1.966349e-01]

Component in direction: [ 1.000000e+00,  0.000000e+00,  0.000000e+00] in Laboratory coordinate system
Part                            Pressure()    Shear()       Net()
------------------------------ ------------- ------------- -------------
Surface Wrapper.put.Surface      1.232677e-01  3.500414e-03  1.267681e-01
------------------------------ ------------- ------------- -------------
Totals:                          1.232677e-01  3.500414e-03  1.267681e-01

Monitor value: 0.12676807643645835
```

Lessons Learned

- This project exposed me to CFD simulation principles currently used in the industry.
- Now I have a better understanding of fluid dynamics and heat transfer.
- Able to conceptualize a CFD problem.
- Learnt the process of mesh generation.
- Able to define and solve a fluid flow CFD problem.
- Use the results for making design decisions.

Thank You
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