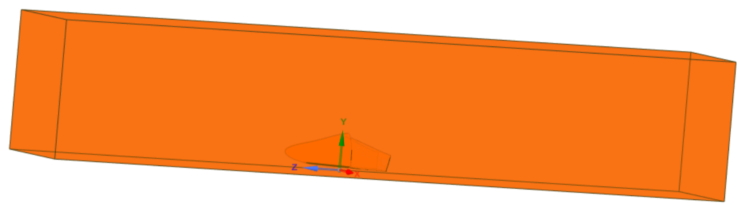
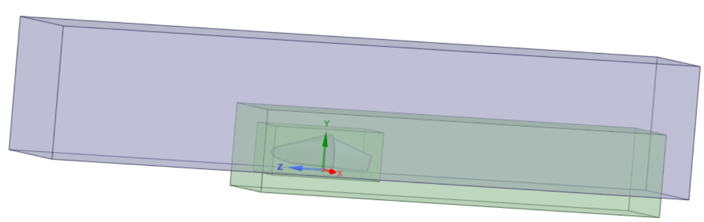
1) General Geometry setup:

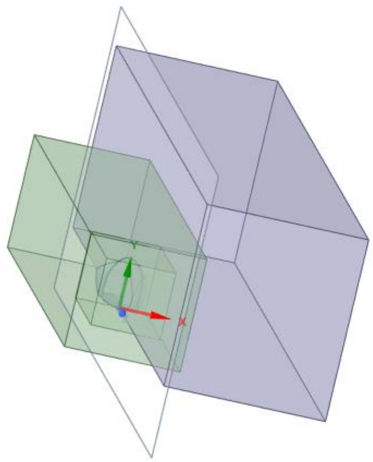
- The wind tunnel is extended to 3 times the length of the nosecone so that the CFD analysis would captures the wake region in the back



Two boundary field were created for later computational and meshing simplicity reasons



Since the nosecone is symmetric, the wind tunnel is cut into to a half to reduce the time and computational cost



2) General mesh setup:

To get better CFD results, the mesh generated much be refined at the points of interest which is the closed boundary to the body and the curvature shaped nosecone

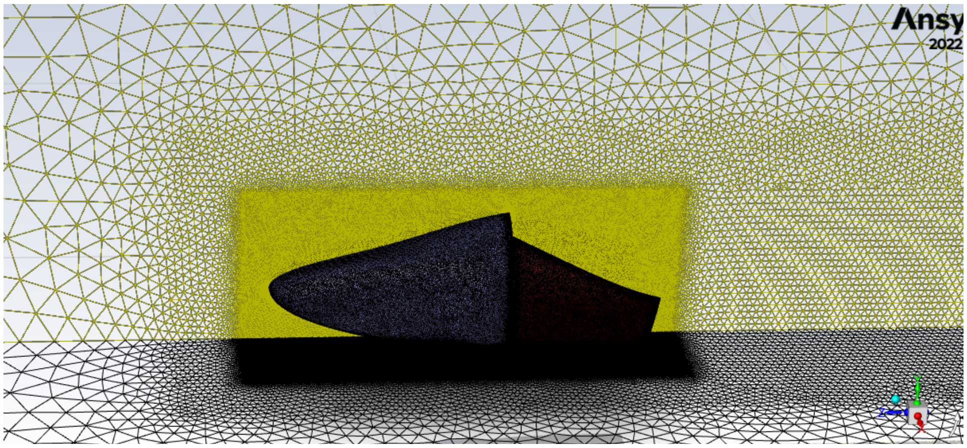
Mesh size:

Generate the Surface Mesh

Minimum Size [mm]	0.5
Maximum Size [mm]	256
Growth Rate	1.2
Size Functions	Curvature & Proximity
Ignore Proximity Across Objects?	No
Curvature Normal Angle [deg]	18
Cells Per Gap	3
Scope Proximity To	edges
☑ Draw Size Boxes	
Separate Out Boundary Zones by Angle?	No
+ Advanced Options	

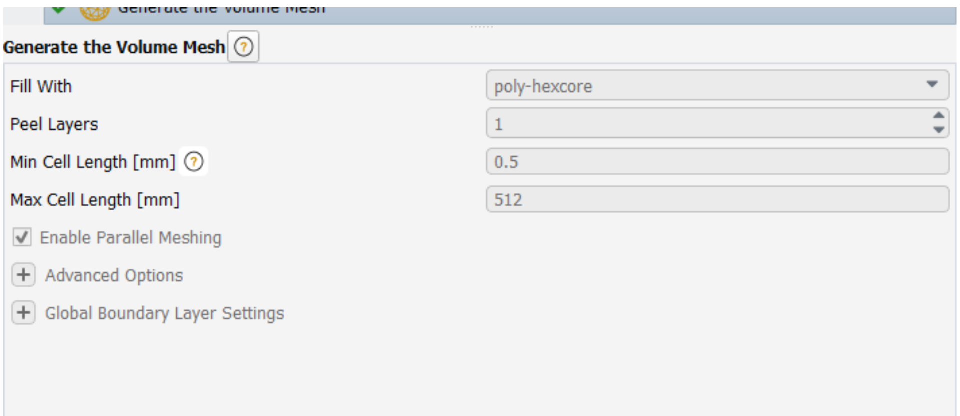
Mesh Result Result:

A good quality surface mesh, that accounts for the curvature of the nosecone,was obtained

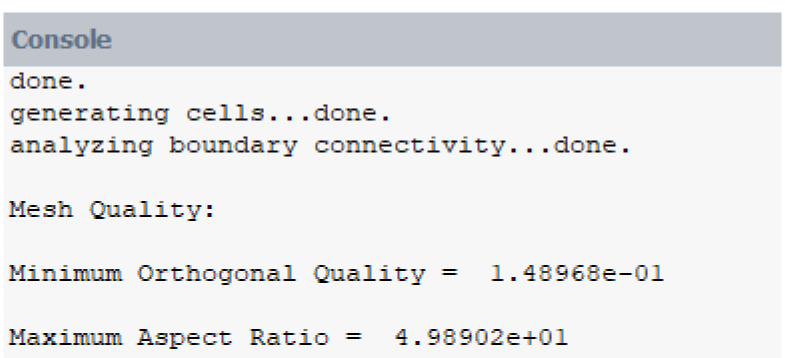


3) Volumetric mesh:

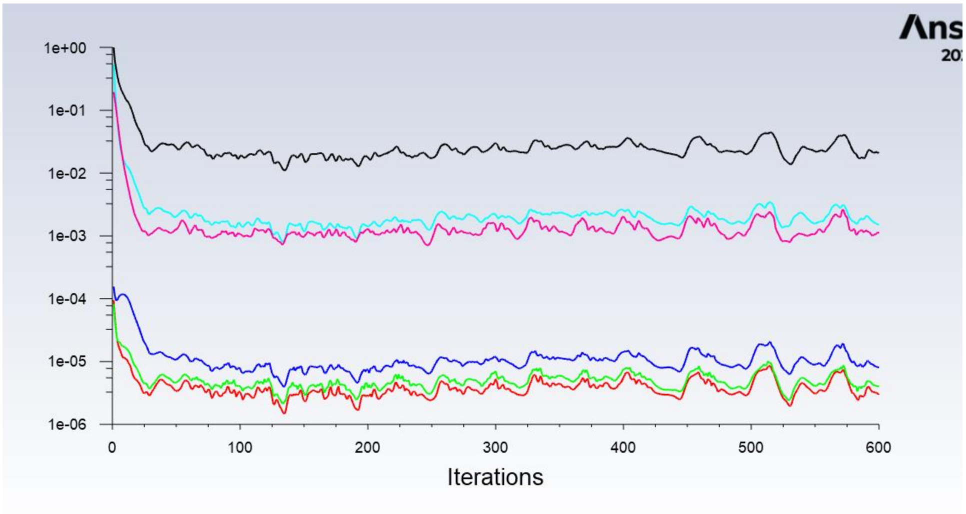
A poly-hexacore mesh type was chosen with a maximum cell length of 512 mm and minimum cell length of 0.5 mm

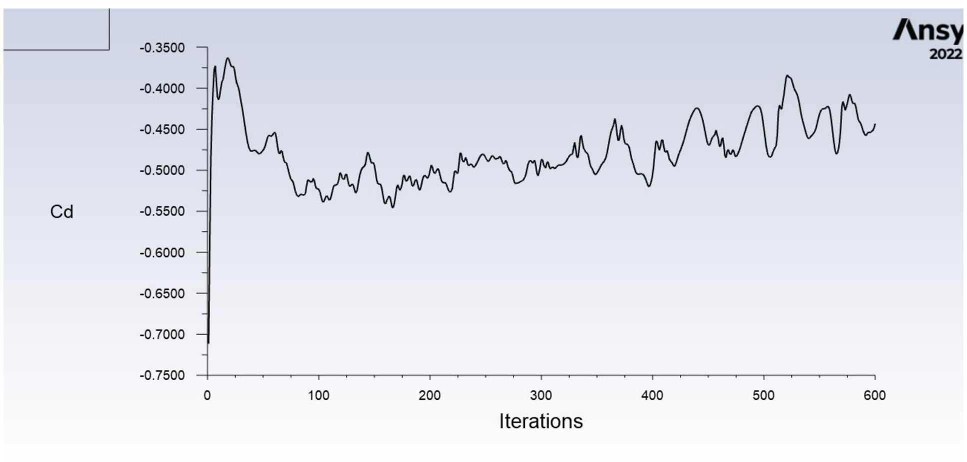


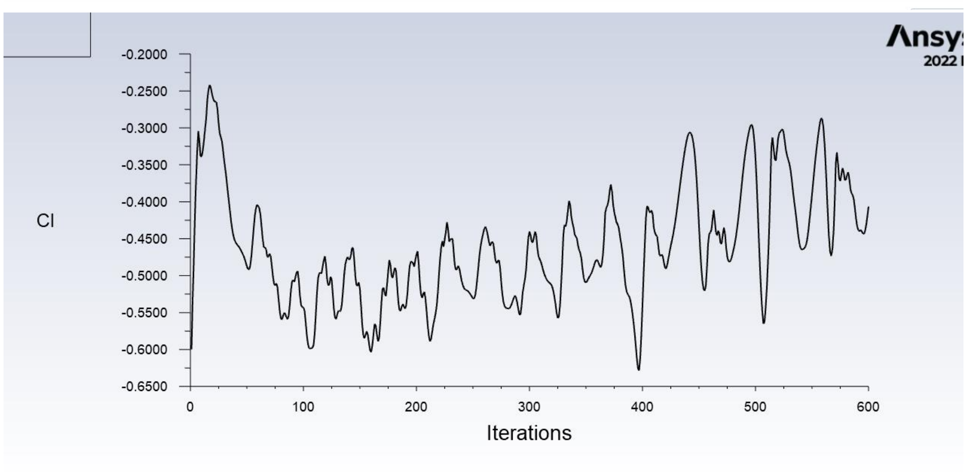
Since the minimum orthogonal quality was found to be more than 0.1 , then the obtained volumetric mesh is workable for simulation



5) Simulations Results:







Average Drag Force:

Note: the negative sign indicates that the force is in the opposite z-direction

Forces - Direction Vector (0 0 1)

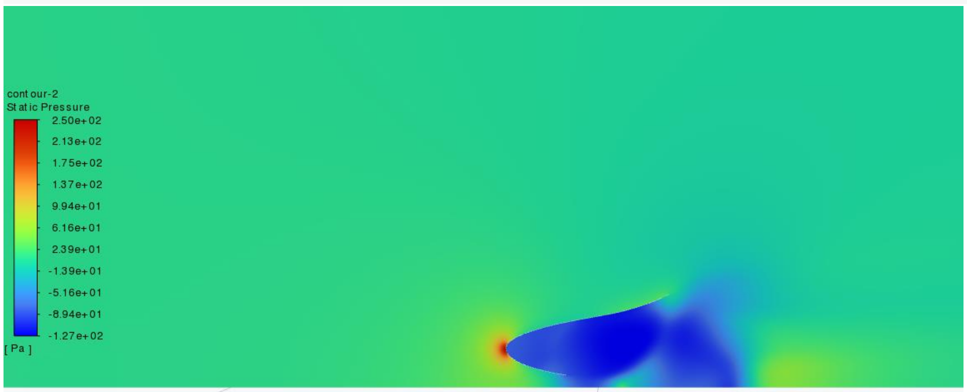
	Forces [N]			Coefficients		
Zone	Pressure	Viscous	Total	Pressure	Viscous	Total
nosecone	-17.150545	-0.87364269	-18.024187	-0.42170015	-0.021481257	-0.44318141
Net	-17.150545	-0.87364269	-18.024187	-0.42170015	-0.021481257	-0.44318141

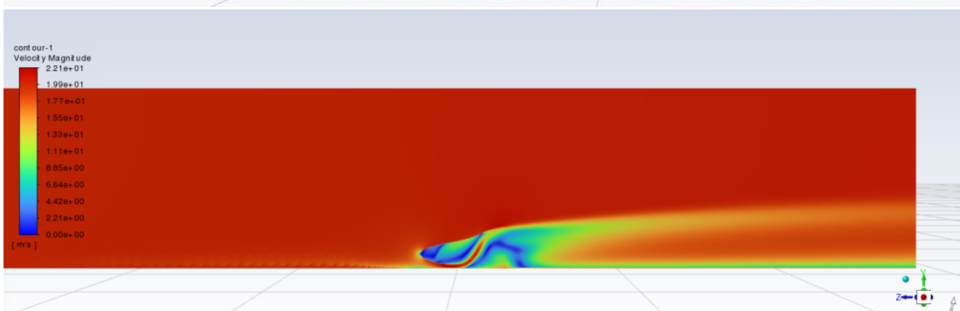
Average Left

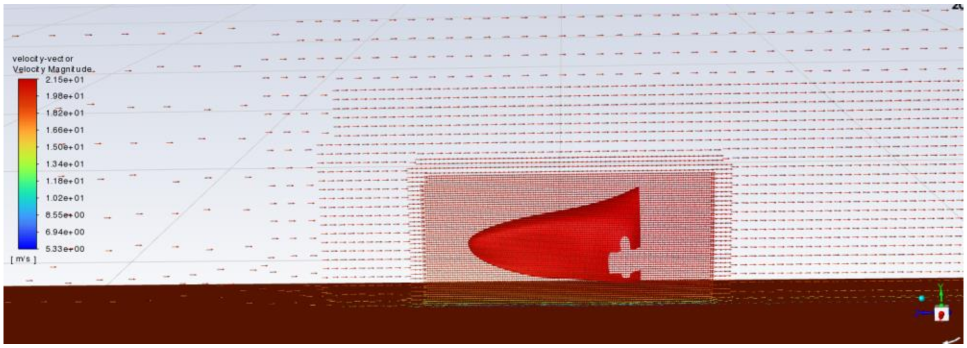
Note: the negative sign indicates that the force is acting downward(downforce)

Forces - Direction Vector (0 1 0)

	Forces [N]			Coefficients		
Zone	Pressure	Viscous	Total	Pressure	Viscous	Total
nosecone	-16.550665	0.020606716	-16.530058	-0.40695023	0.00050668102	-0.40644355
Net	-16.550665	0.020606716	-16.530058	-0.40695023	0.00050668102	-0.40644355







Note: This simulation is time-consuming, and I cannot proceed with simulating individual aero parts. It takes days to do the pre-processing itself and simulations take about 2 hours with these week campus computers. Most CAD models we have require lots of cleaning to create an appropriate mesh with them.

My new strategy is to run two more simulations. One is in the full assembly without the aero kit and the other with the aero kit. That would be enough to justify installing the aero package. We don’t have the hardware nor the time to run extensive CFD simulations. All what I’ve suggested above came after evaluating extensively many fsae teams' aero packages and personal experience with cfd simulations