

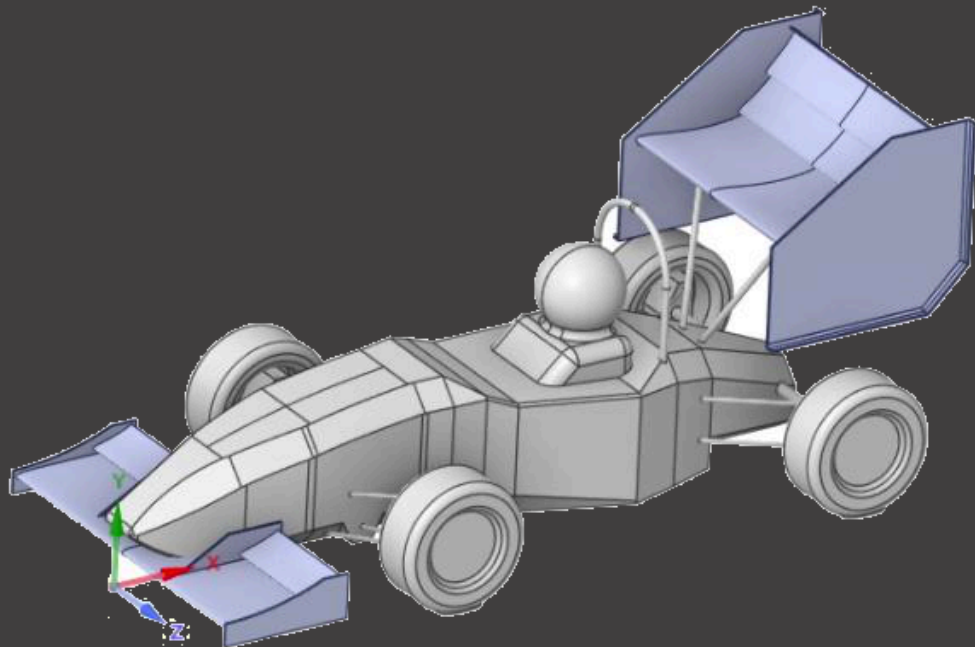


CASE STUDY · AUTOMOTIVE

FSAE AERO

EXTERNAL AERODYNAMICS CFD
WITH NEXUS & ANSYS FLUENT

Tools Nexus · ANSYS Fluent 2026 R1 · SpaceClaim
Outcome 50% time saved



WHAT'S INSIDE

A walk-through of how Nexus took an FSAE external-aero CFD study from ~12 hours of manual work down to ~6 — mesh, setup, results and design takeaways.

Summary

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The headline outcome — 50% time saved, Cd 1.145 / Cl -1.794.

Problem

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License-bound mesh cap, best-practice sizing and post-processing overhead.

Methodology

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Mesh convergence, case setup and design guidance with Nexus.

Results

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Agent-generated CFD results — streamlines, wall shear, velocity, wake.

Agent Design Input

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Prioritized ΔC_d / ΔC_l recommendations with a mesh-fidelity caveat.

Try Nexus

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How to bring the same workflow to your own CFD studies.

SUMMARY

A full external-aero CFD workflow, delivered in half the time.

A Formula Style (FSAE) open-wheel race car was simulated at 20 m/s in ANSYS Fluent, driven through Cosmon's Nexus AI agent. End-to-end engineering time dropped from **~12 hours to ~6 hours**, and the agent reduced the mesh to the minimum number of nodes needed to find convergence — from **5.44M cells down to 799,538** — without losing physical fidelity. Final: $C_d = 1.145$, $C_l = -1.794$ (downforce ~439 N).

50%

ENGINEERING TIME SAVED

85%

REDUCTION IN MESH SIZE ACHIEVED

1.57

L/D RATIO PREDICTED (DOWNFORCE/DRAG)

PROBLEM

Open-wheel aero is a high-cell-count problem, and these constraints compound for any team running on a constrained workstation.

01 Best-practice sizing

Hitting both the cell budget *and* a log-law y^+ band usually takes a senior CFD engineer several iterations.

02 Post-processing overhead

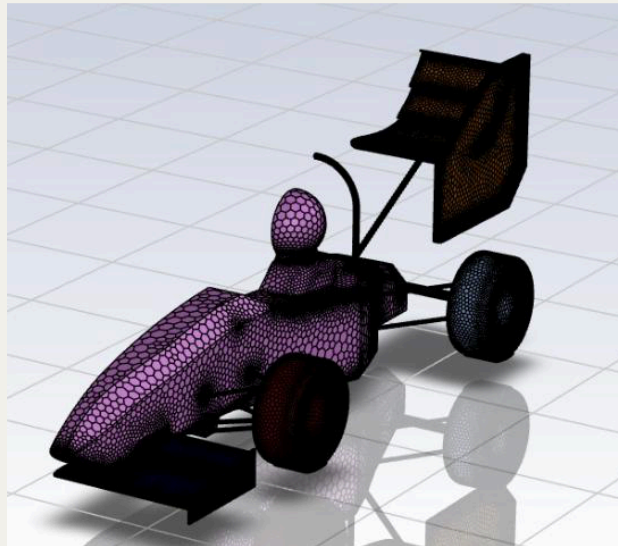
Building velocity, pressure, wall-shear, y^+ and wake contours manually is 4+ hours of GUI work per case.

+ Benefit to engineer

Minimum fidelity mesh without losing $k-\omega$ SST log-law physics · auto-generated contours with embedded flow-physics insight · design recommendations quantified by $\Delta C_d / \Delta C_l$ impact.

METHODOLOGY

Half-car FSAE geometry imported live from SpaceClaim. Nexus proposed mesh settings, predicted cell counts *before* running the mesher, iterated through mesh convergence and proposed targeted reductions — turning an open-ended blocker into a 5-step problem.



FINAL SURFACE MESH · 2 PRISM LAYERS · MAX SKEW 0.69

ITER	SURF MIN	BOI NEAR / FAR	BL	CELLS
1	0.5	16 / 64	10	~5.44 M
2	0.5	24 / 64	4	3.68 M
3	2	32 / 128	3	1.46 M
4	2	48 / 132	2	1.35 M
5	4	64 / 256	2	799 K

+ Nexus proposed setup with best-practices

Turbulence model (k- ω SST), inlet turbulence quantities (TI 5%, VR 2), reference frontal area (0.4997 m²) and rotating-wheel BCs all proposed by Nexus.

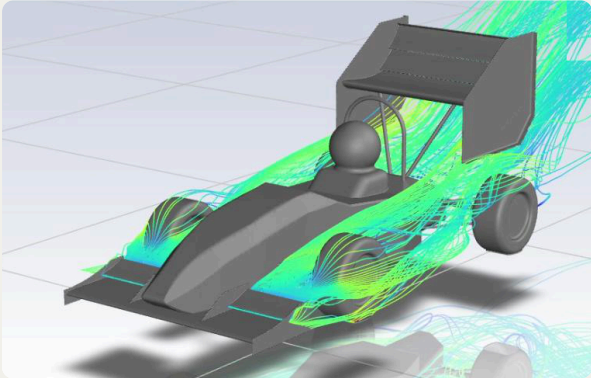
+ Quantified design guidance

Prioritized L/D wins with ΔC_d / ΔC_l estimates — aggressive diffuser ramp (ΔC_d -0.05, ΔC_l -0.30), wheel turning vanes (ΔC_d -0.05, low effort) — targeting $C_d \sim 0.95$ next iteration.

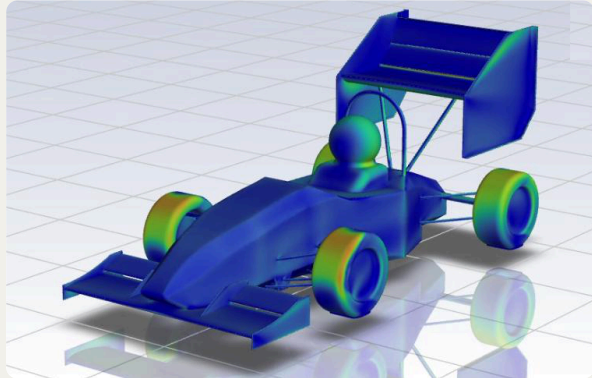
RESULTS

PHASE	MANUAL	WITH NEXUS	SAVINGS
Mesh generation	~6 h	~3 h	-50%
Case setup (BCs, turbulence, references)	~2 h	~1 h	-50%
Post-processing + report preparation	~4 h	~2 h	-50%
Total	~12 h	~6 h	-50%

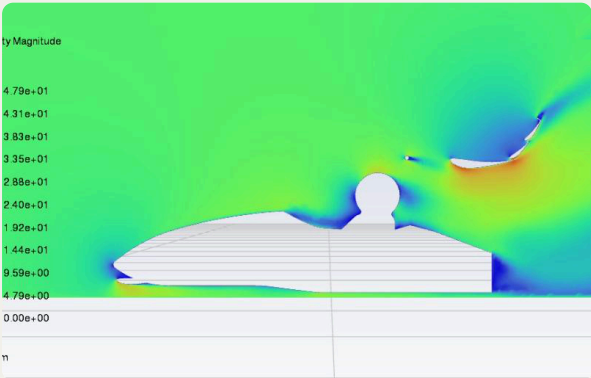
Every contour below was generated with Nexus — no manual scripting or clicking in Fluent. After constructing results, the engineer asked the agent for design recommendations, and it paired each visualization with flow-physics commentary that translated directly into design actions.



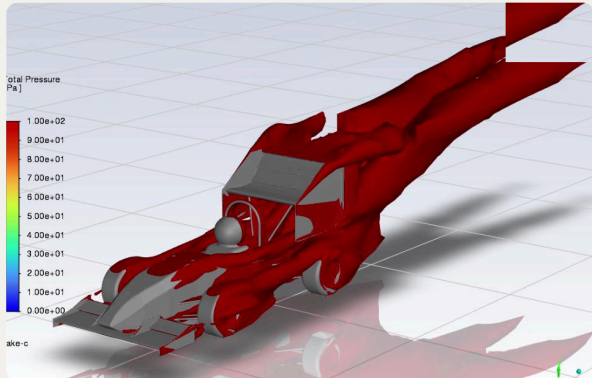
Streamlines · front-wing inlet
 Ground-effect speed-up at 24–32 m/s, strong upwash over chassis, coherent bundle through the wing channel — consistent with the negative Cl.



Wall shear stress
 Highest WSS on rotating tire shoulders (doubled effective slip velocity) — confirms rotating-wheel BCs active. Wheels dominate viscous drag.



Velocity, symmetry plane
 Bow-wave acceleration above the helmet (~30–35 m/s), wake deficit drops to ~10–18 m/s — ~3x car length downstream.



Wake envelope · total pressure
 Iso-surface at >60% P0 loss. Rear plume from wings, chassis and wheels is the dominant Cd driver. Underbody stays clean — attached, high-energy.

AGENT DESIGN INPUT

After the run, the engineer asked Nexus to suggest design changes to reduce drag and increase downforce. The agent paired each recommendation with a $\Delta C_d / \Delta C_l$ estimate and an effort tag — and led with a mesh-fidelity caveat so the suggestions are read as directional, not absolute.

! Mesh-physics caveat — flagged by the agent first

Current mesh has **2 prism layers**, y^+ mostly 30–250, no wake refinement behind wheels/rear-wing. Skin friction is captured cleanly; wake and separation regions carry $\pm 10\text{--}15\%$ uncertainty on pressure drag. Treat suggestions as **directional** — confirm winners with A/B comparisons on the same mesh.

QUICK-WIN PRIORITY LIST · BEST L/D GAIN PER EFFORT

#	CHANGE	EST. ΔC_D	EST. ΔC_L	EFFORT
1	Front-wing 2nd element + endplate curl	-0.02	-0.20	Medium
2	Aggressive diffuser + floor strakes	-0.05	-0.30	High
3	Front-wheel turning vanes	-0.05	0	Low
4	Rear-wing Gurney + slight incidence reduction	-0.03	-0.10	Low
5	Roll-hoop fairing + boat-tail engine cover	-0.04	0	Medium

A Drag — wake is the dominant C_d source

Wheels are the single biggest contributor — add fairings / partial shrouds and cover unused brake ducts. Reduce rear-wing AoA by $1\text{--}2^\circ$ or swap incidence for a Gurney flap (better L/D trade). Energize the base wake with a beam wing or boat-tailed engine cover.

B Downforce — load the underbody

Add a 2nd-element flap to the front wing and curl the endplate footplate to strengthen the leading-edge vortex. Steepen the diffuser ramp ($5\text{--}10^\circ$), add floor strakes to seal the underbody, drop ride height 5–10 mm if mechanically feasible.

→ Before re-running CFD on any redesign — fix the mesh

Increase prism layers to 5–8 · refine the wake region behind car and front-wing endplates · target y^+ in the 30–80 band globally. Stays inside the 1M cell budget while removing the $\pm 10\text{--}15\%$ pressure-drag uncertainty.



Think through > click through.
Let **Nexus** handle the rest.

YOUR AI AGENT FOR ENGINEERING WORKFLOWS

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