

UWTSD Sports 2000 Aerodynamics Development Project



Project Lead: Tim Tudor (UWTSD)

Project Partners: Students (UWTSD), Clive Hayes (MCR Race Cars), John Iley (Iley Design)



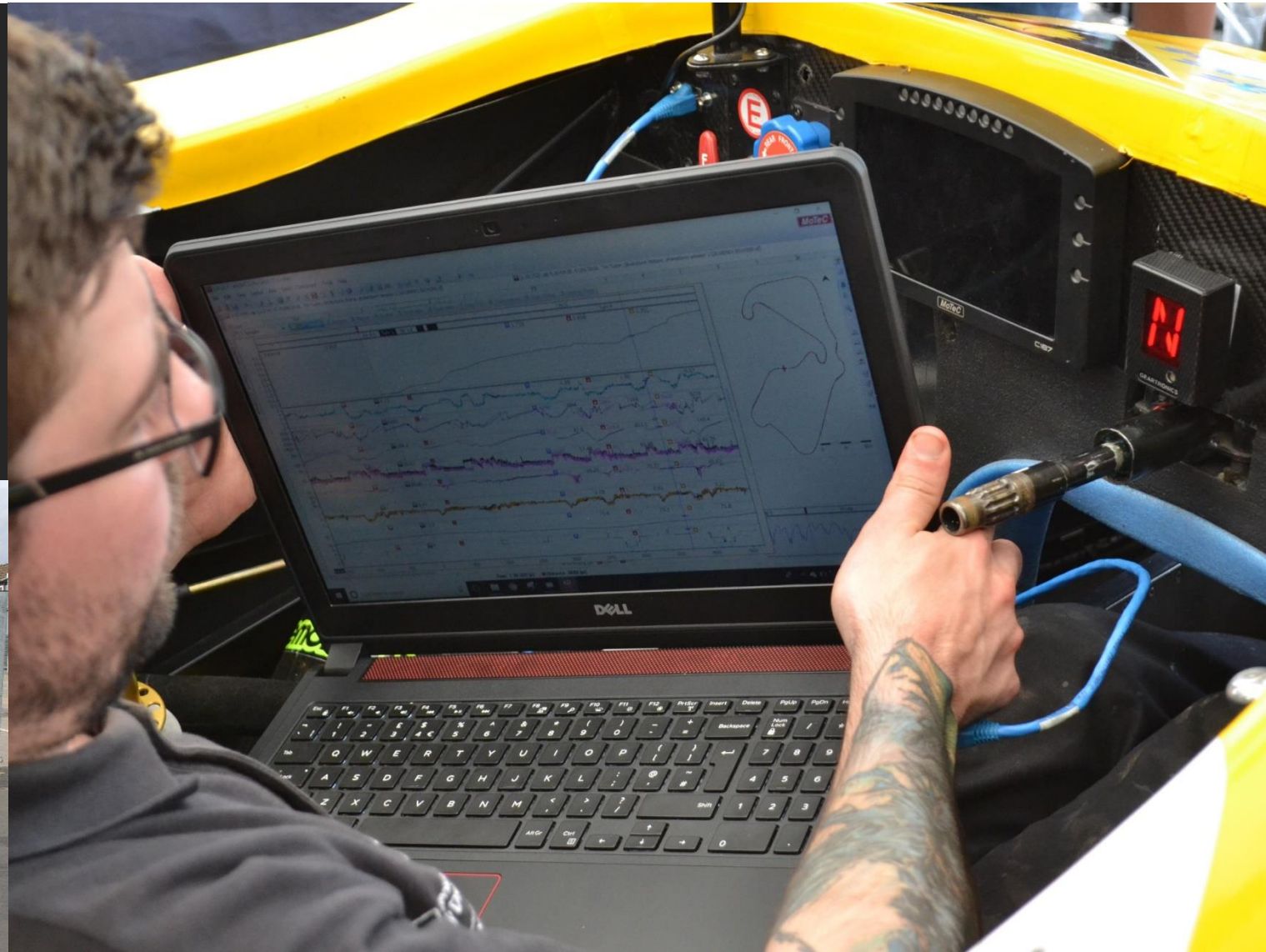
Project Introduction

- Student led race team competes in the UK Sports 2000 Championship
- Engineering development projects (apply theory to practice)
 - Suspension
 - Bodywork
 - Data Acquisition
 - Engine Analysis
 - Aerodynamics
- Gain hands-on race experience
- Compete against professional teams
- Develop team work skills



Project Introduction

- Students started to analyse vehicle (& driver) performance
- Identified areas for improvement
- Initiated focussed development projects



Project Aims

- Aerodynamics was identified as an area of improvement
- Brief :Improve laptime through aerodynamic development
 - Regulations
 - Improve Aerodynamic Efficiency
 - Improve Aerodynamic Balance
 - Increase Aerodynamic Downforce
 - Reduce or Maintain Drag
- This project provided
 - Student Experience
 - Showcase UWTSDs capabilities
 - Publication – case study
 - Opendays
 - Grid of UWTSD designs
 - Employability
 - Industry Collaboration



Professor of Practice

- Project was initiated by Tim Tudor (UWTSD Motorsport Engineering)
- UWTSD Professor of Practice , John Iley offered to work with Tim and students to support the project.
- John has a wealth of Motorsport Aerodynamics experience, leading Aerodynamics departments for many of the Formula 1 teams and other professional series.





Baseline Package Analysis

- Student team conducted a number of aerodynamic development projects
- Full Scale Windtunnel Test @ MIRA
- Instrumentation of Race Car
- Validation of Windtunnel to Track Data
- Excellent correlation: Confidence in methods

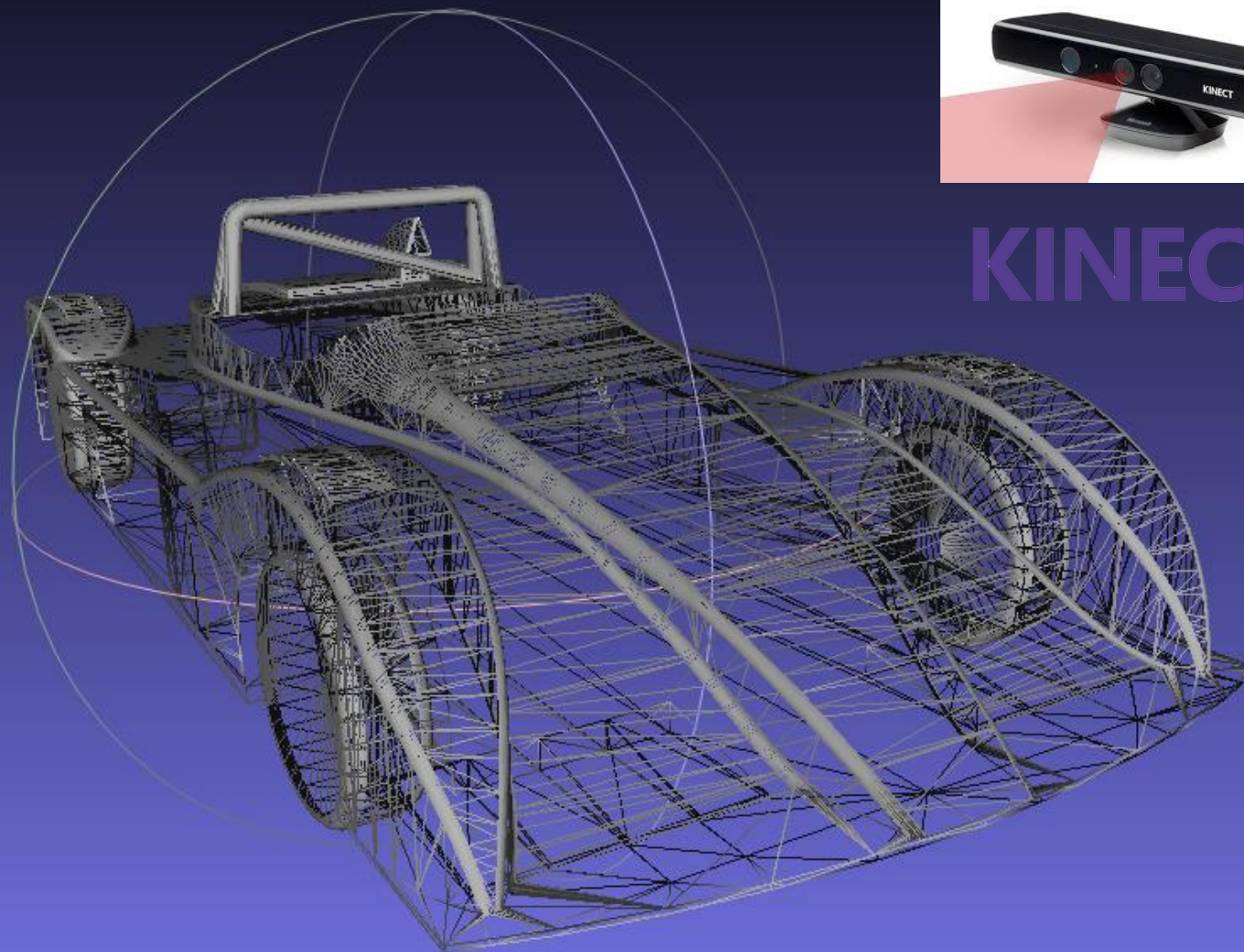
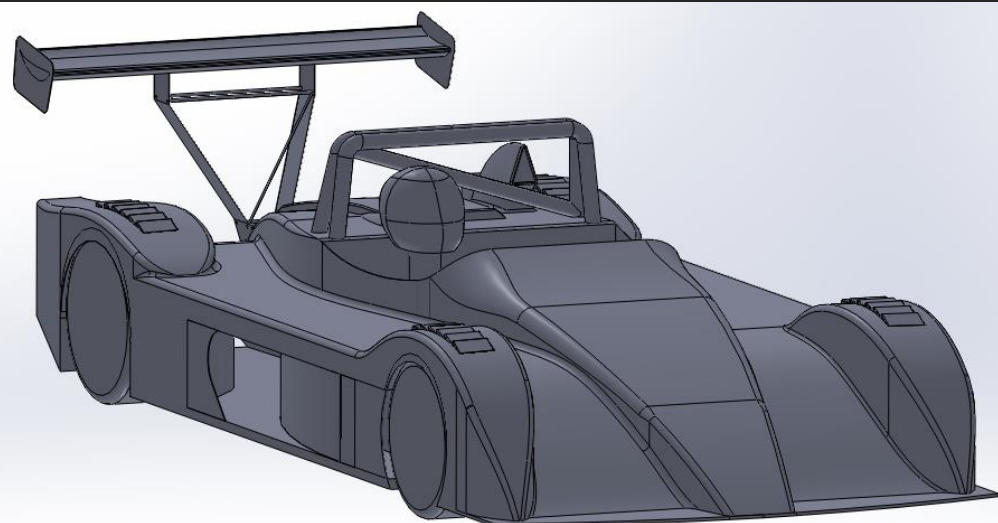


Baseline Package Analysis

- The vehicle was then scanned using an Xbox Kinect and FARO Scenect software
- A CAD model of the car was produced

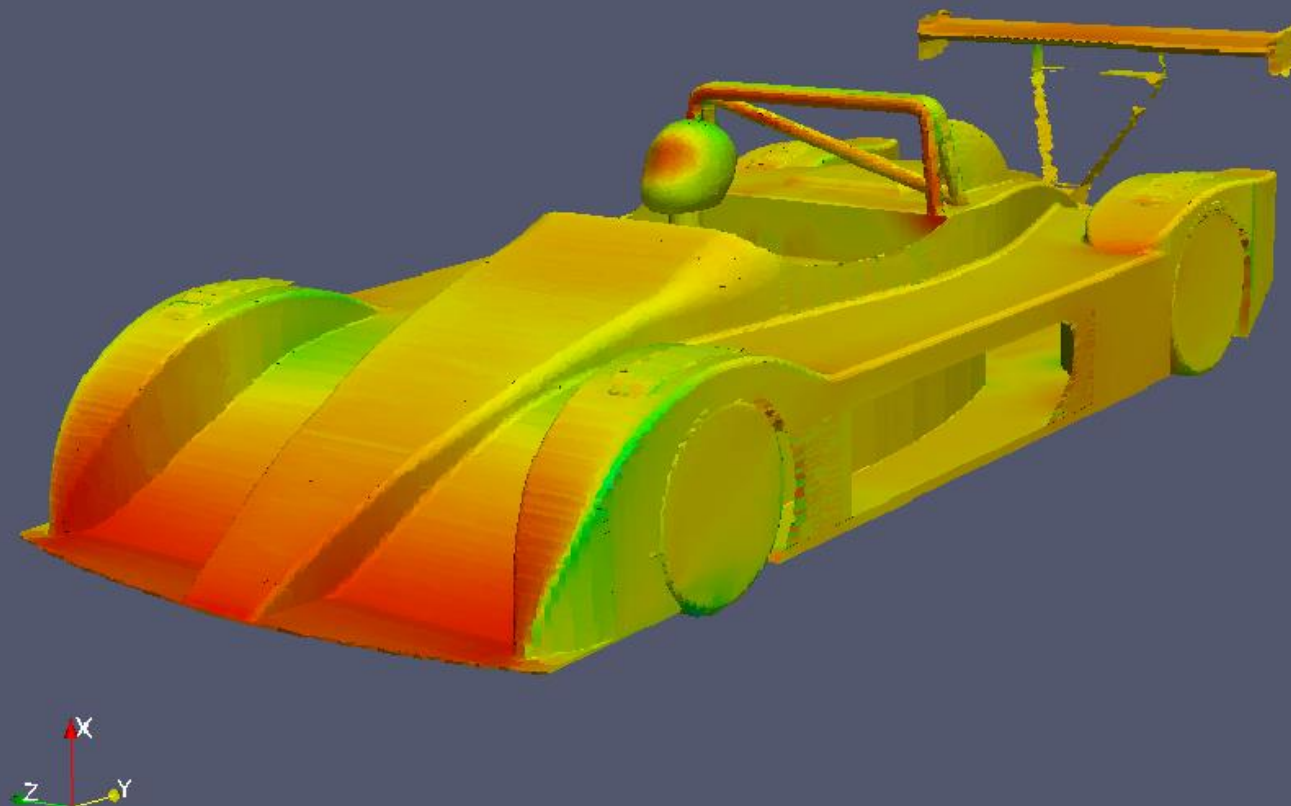


KINECT™

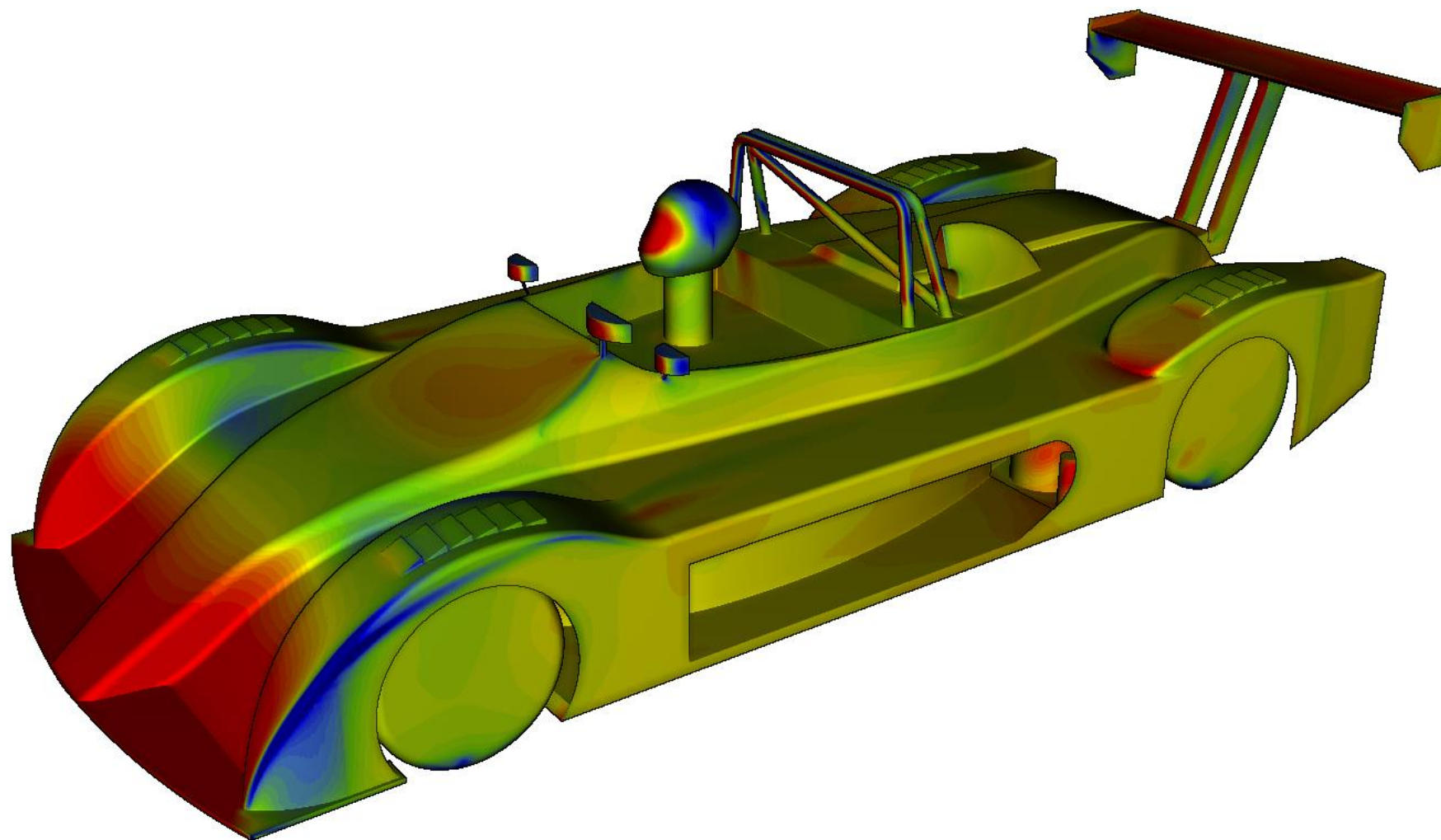


Baseline Package Analysis

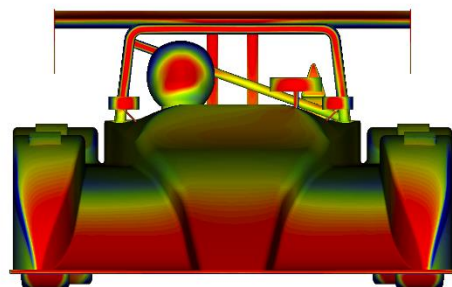
- Development of Computational Fluid Dynamics (CFD) model
- Validation of CFD to Windtunnel to Track Data
- Further validation was achieved by comparison with results obtained from commercial CFD analysis company TotalSim
- Excellent correlation: Confidence in methods



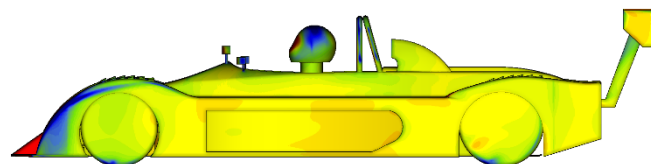




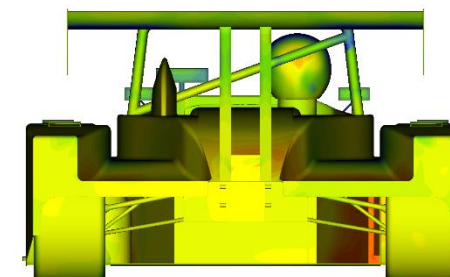
Baseline Package CFD Analysis



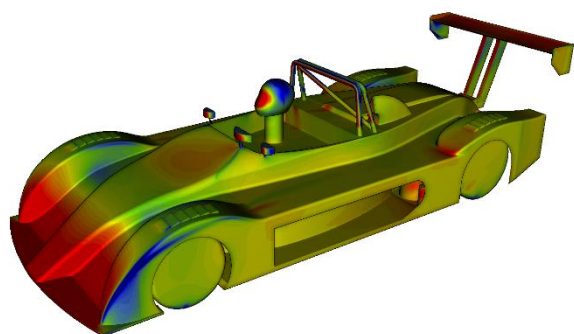
SWA01R002: As R001 with improved mesh recipe
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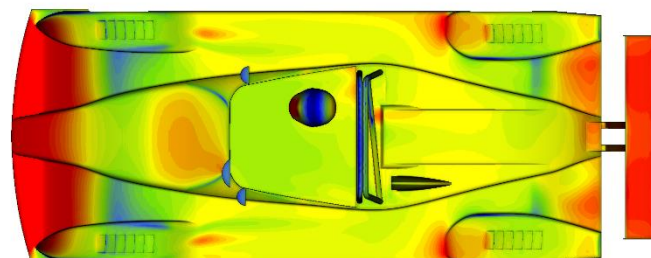
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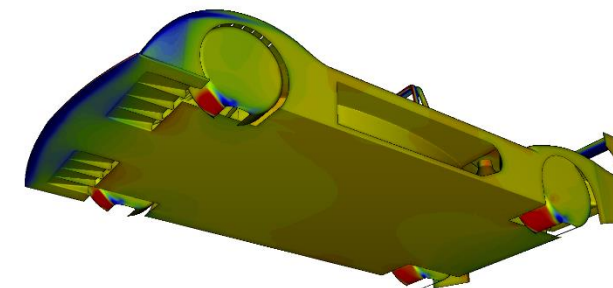
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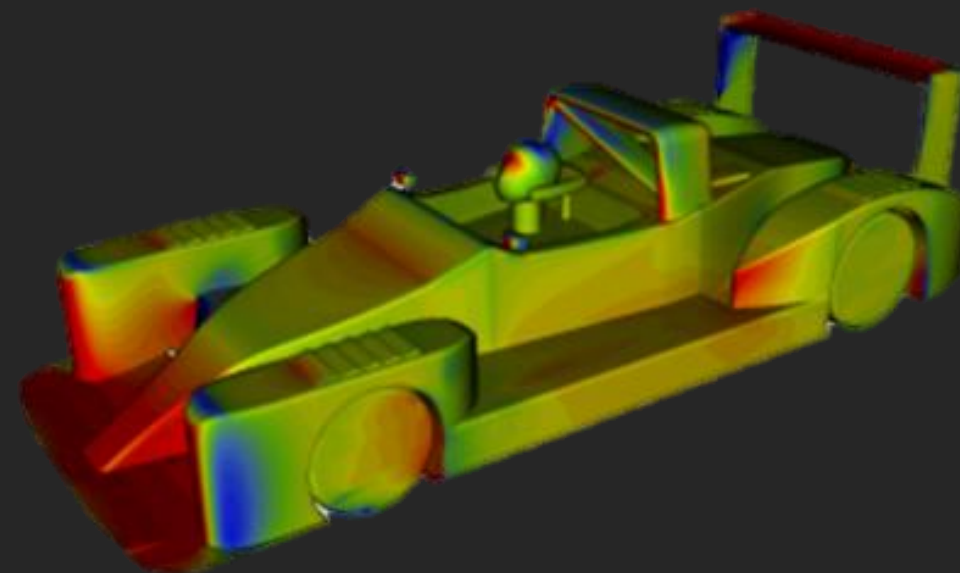
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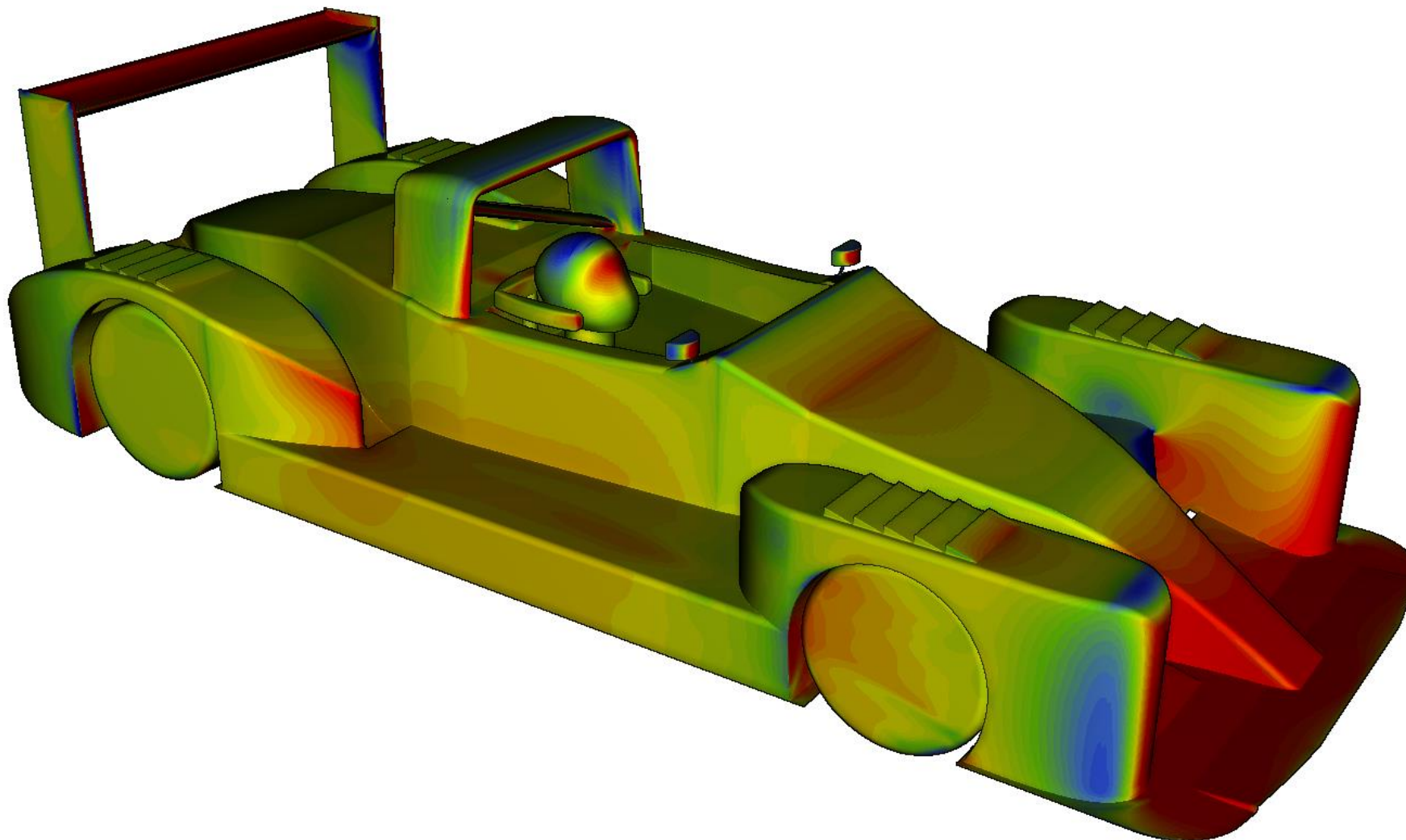


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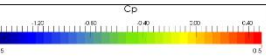
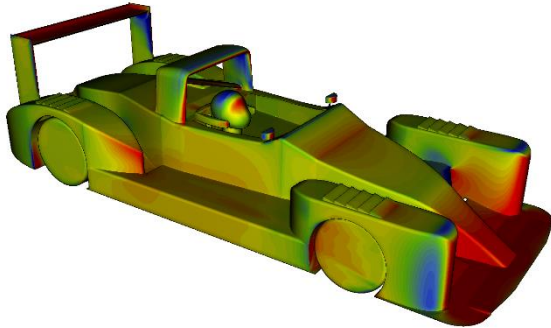
Group Project : Parametric Review

- Five Final Year Major Projects: Focussed areas
 - Front Bodywork & Splitter
 - Pontoons
 - Floor and Rear Deck
 - Rear Wing
 - Cockpit
- Full Parametric Design Evaluation
- Encouraging Aerodynamic Improvements Identified
 - Double Downforce
 - Negligible Drag Increase
 - Double Efficiency
- Greater Knowledge of Performance

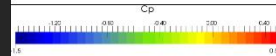
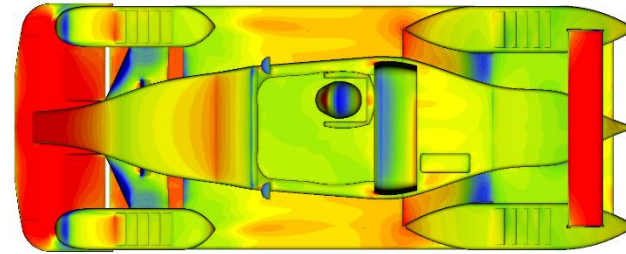




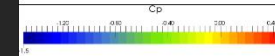
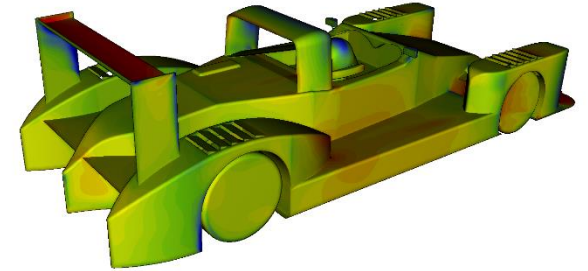
Group Project: Parameterised Package CFD Analysis



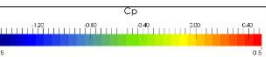
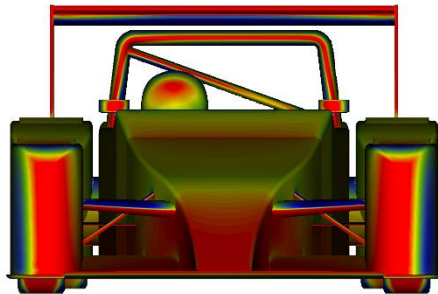
SWA01R003: As R002 with updated geometry
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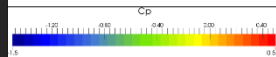
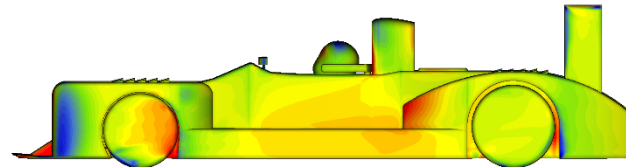
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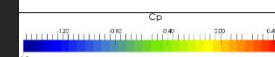
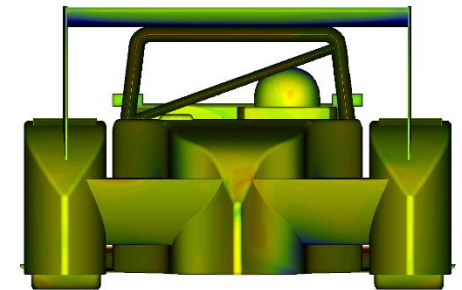
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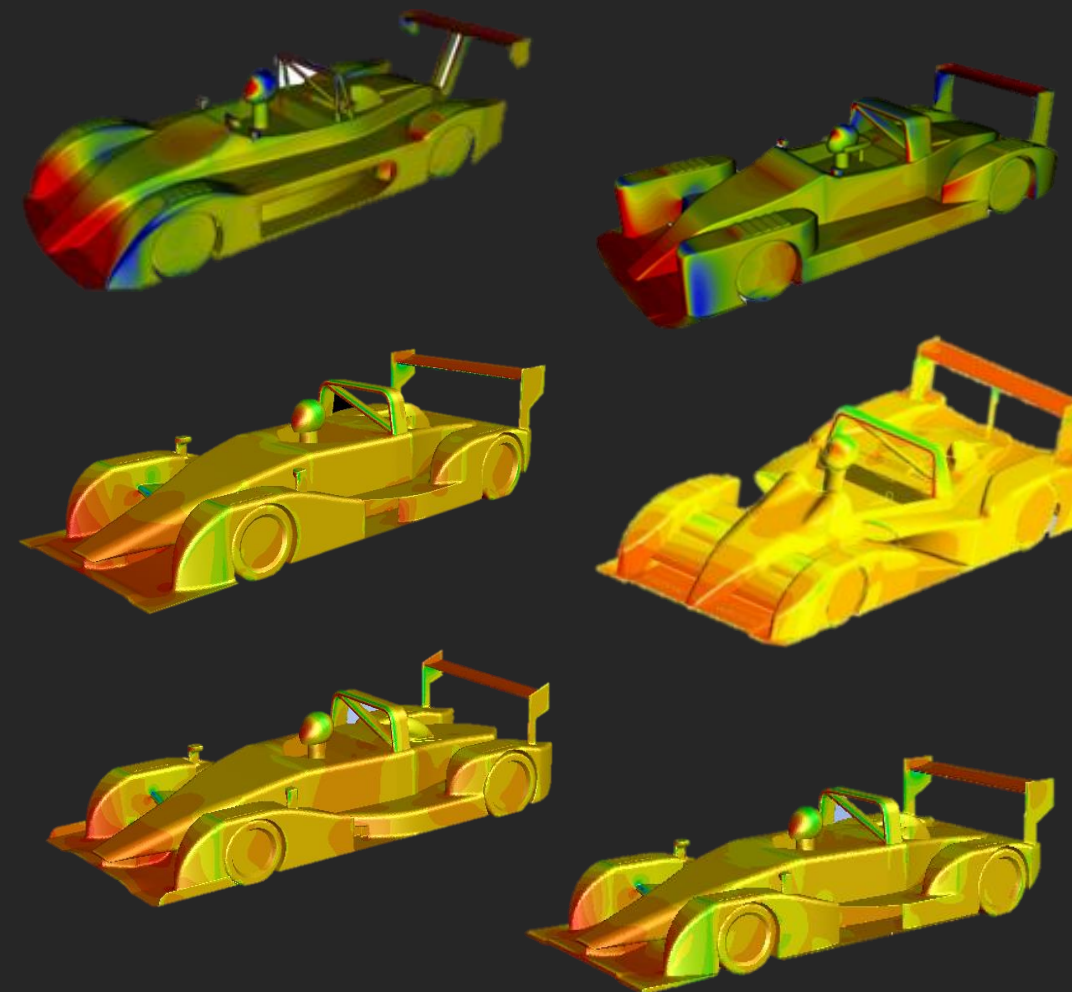


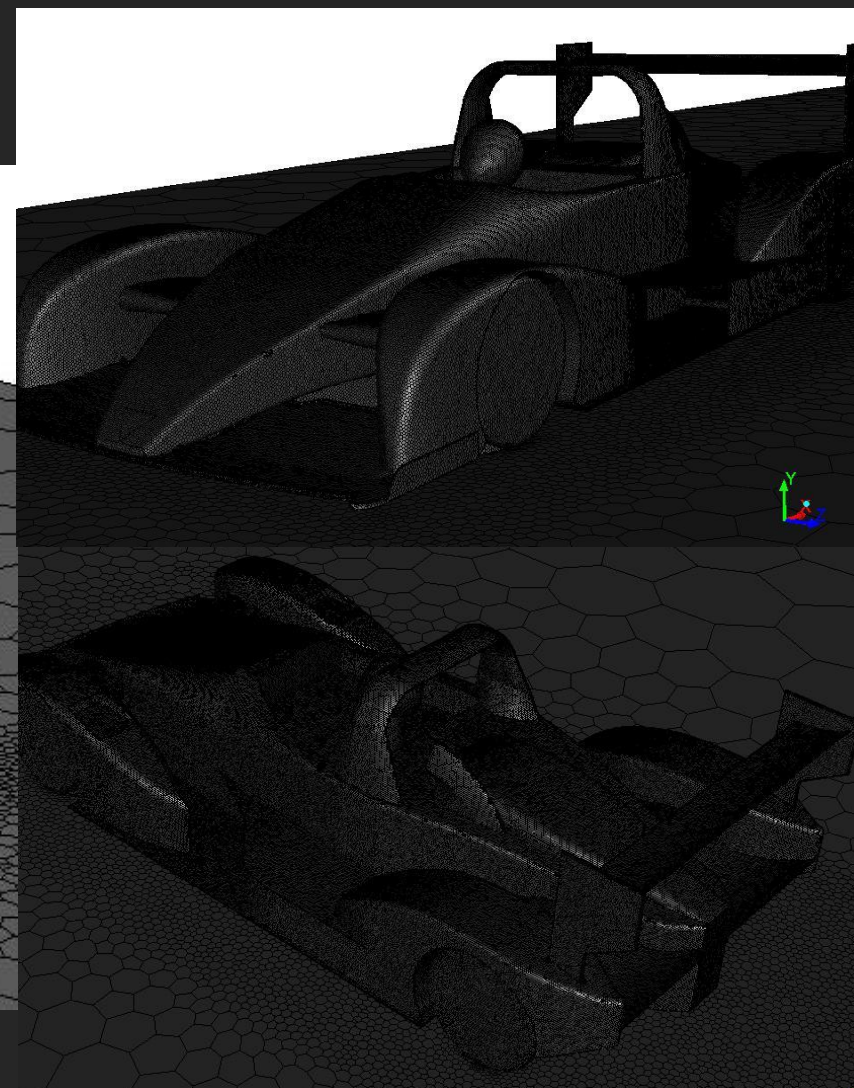
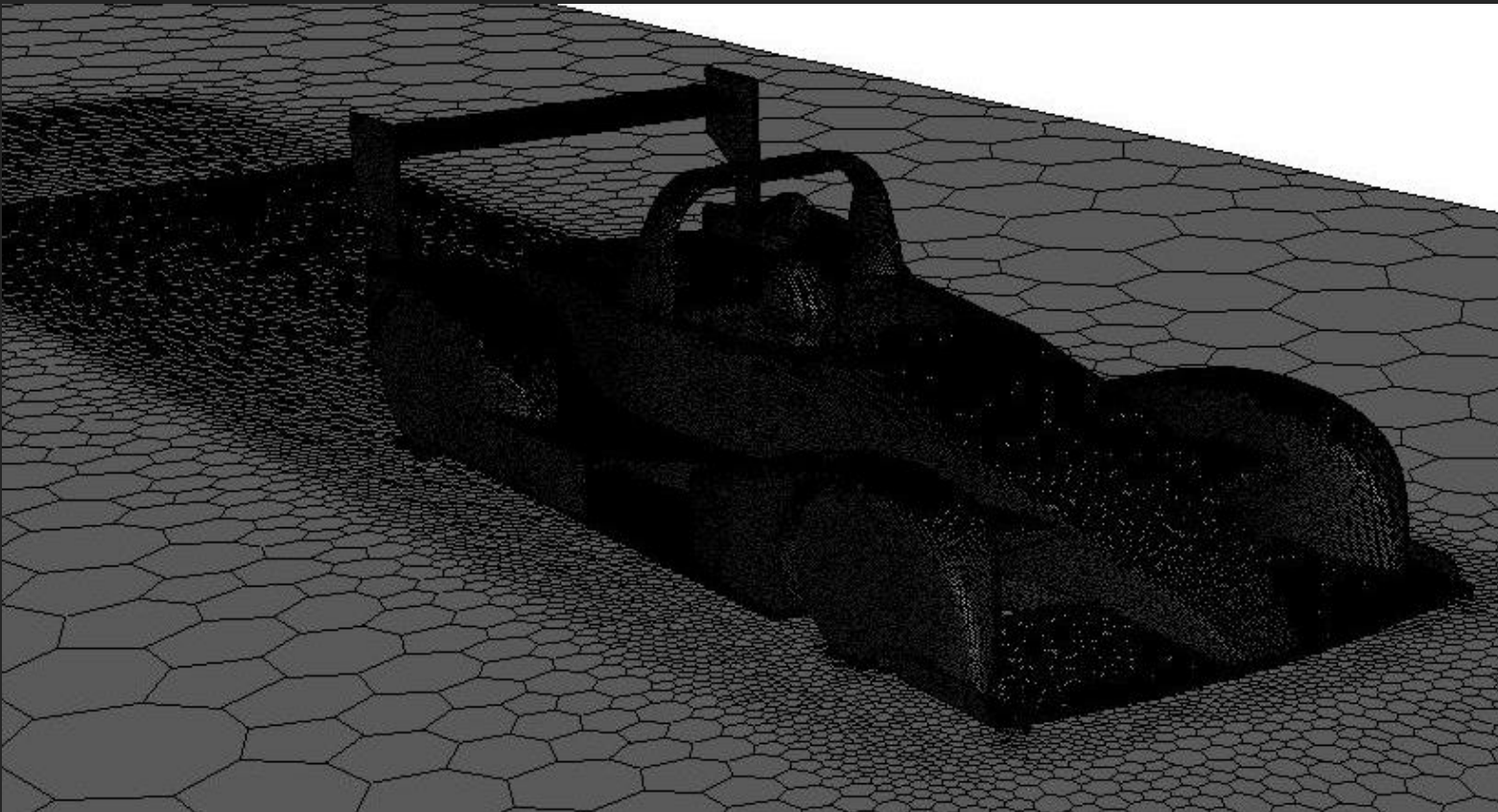
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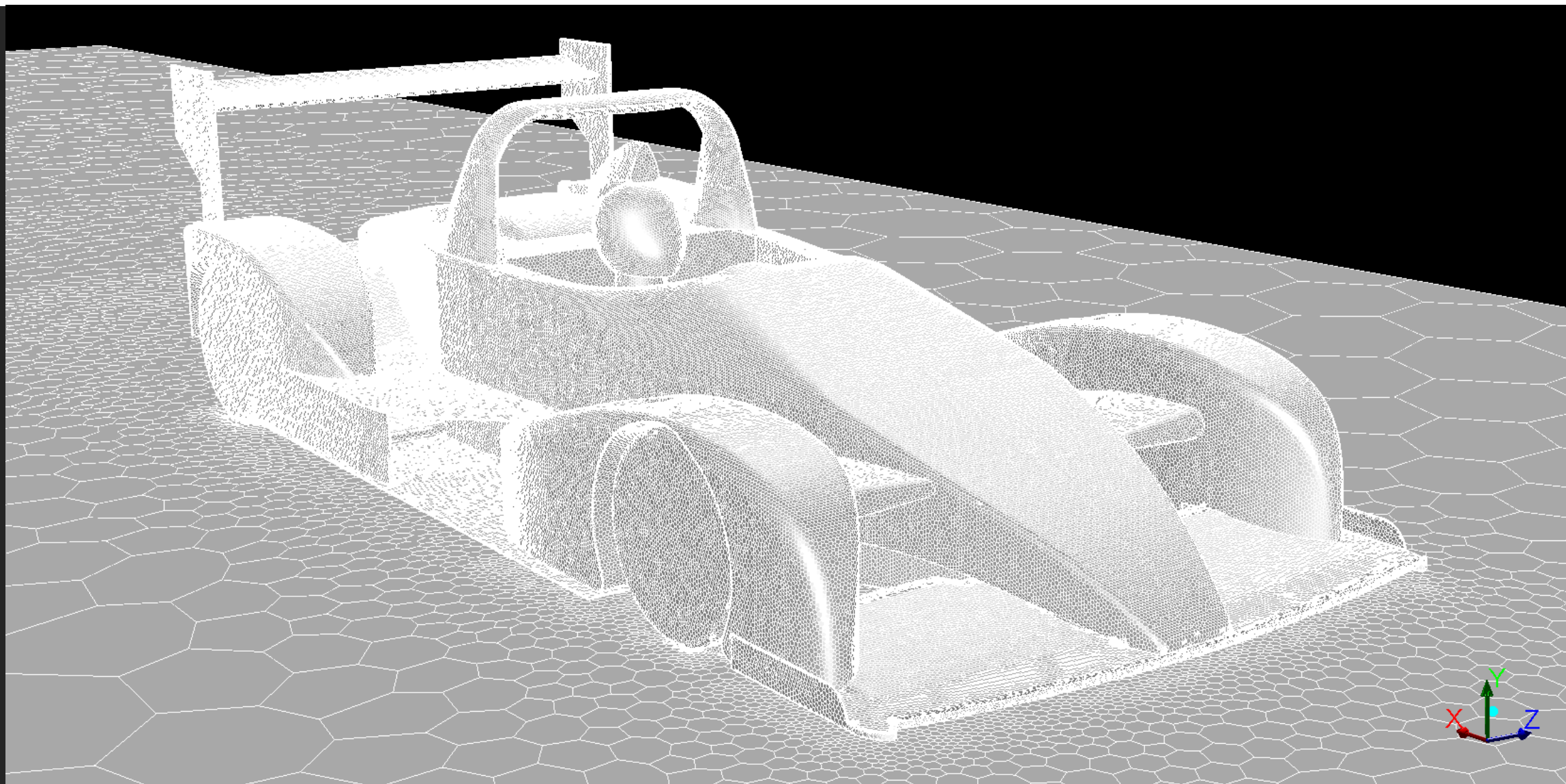
Aerodynamic Development

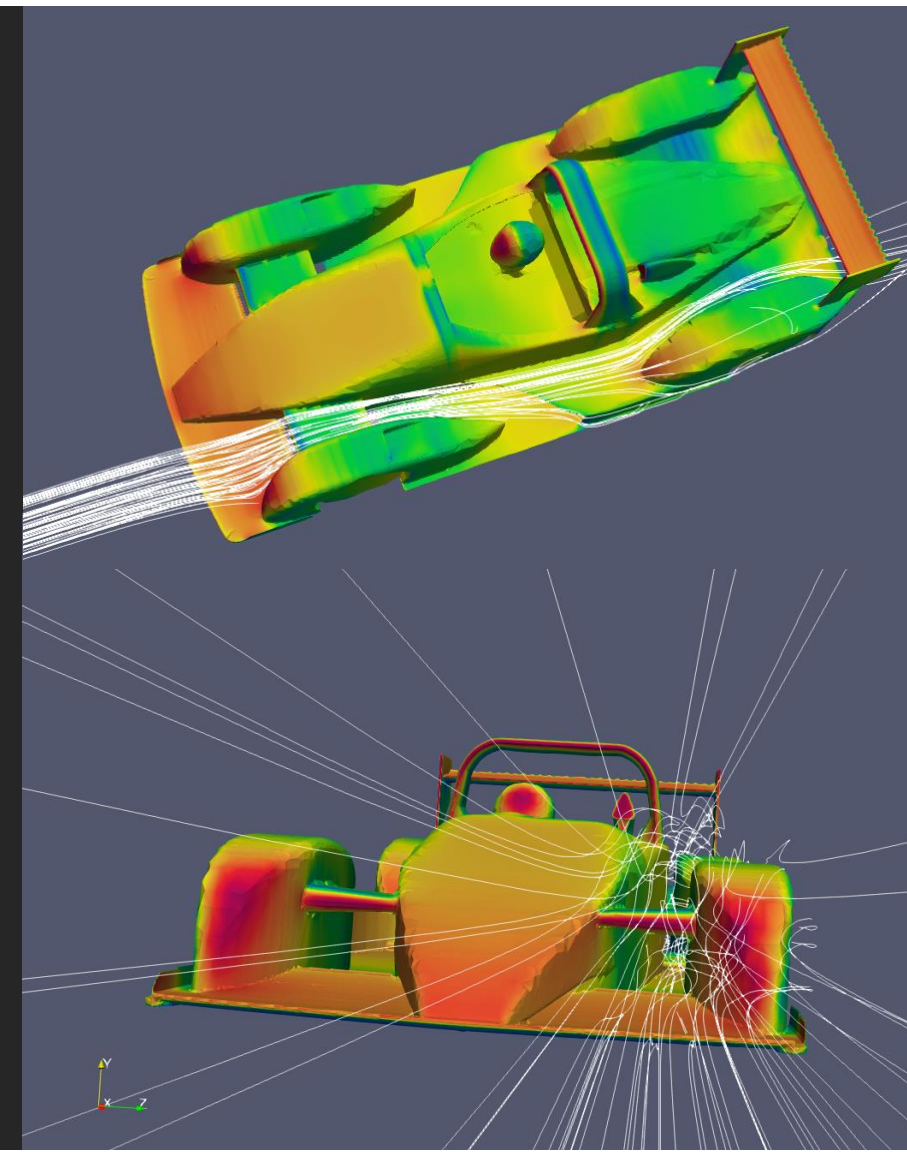
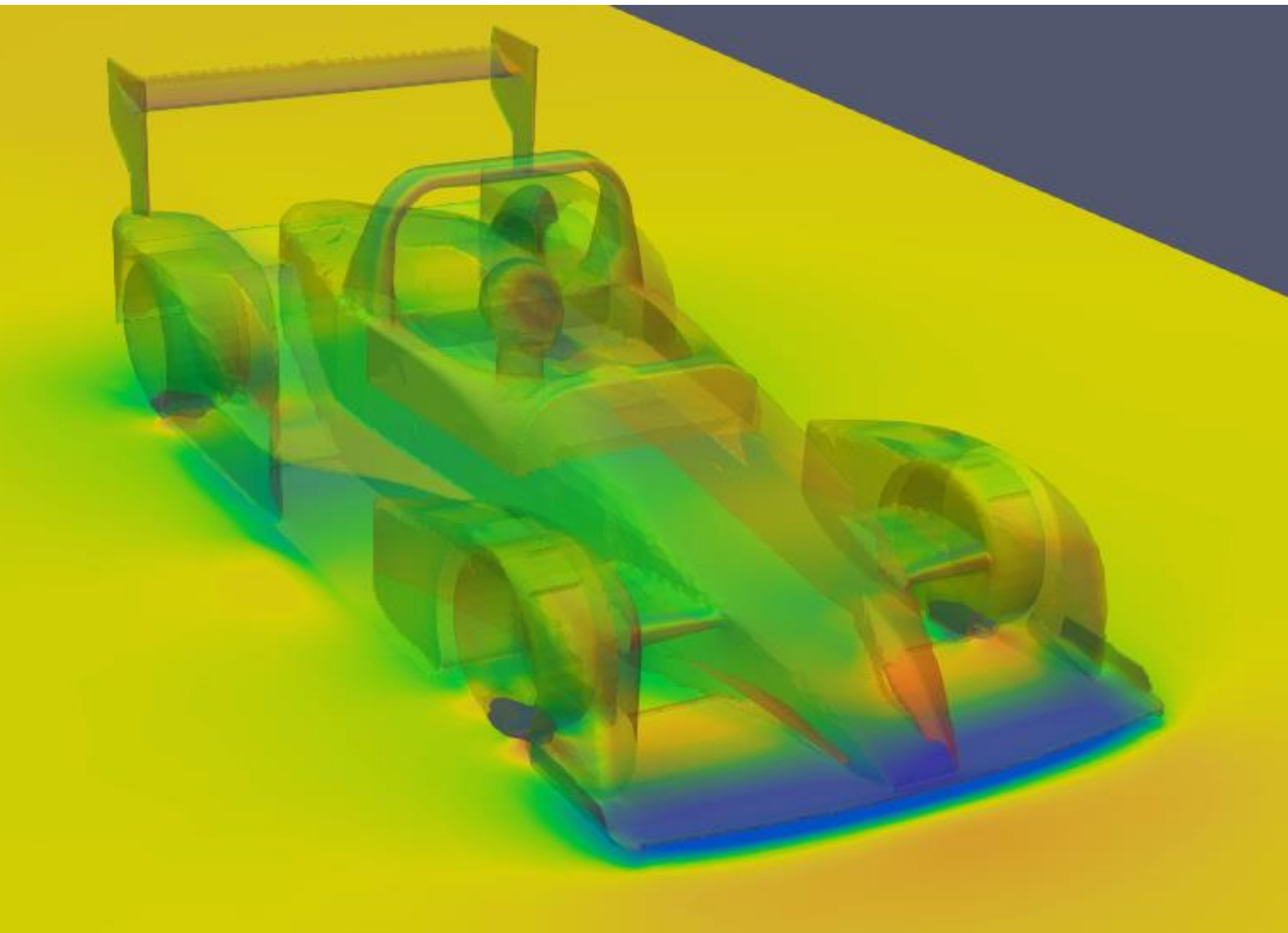
- Student Projects
 - Final Year Projects
 - MSc Project
 - Foundation Project
- Development conducted using CFD method validated on the baseline and through comparison with industry CFD results for supplied geometry (TotalSIM)
- Over 25 Configurations tested

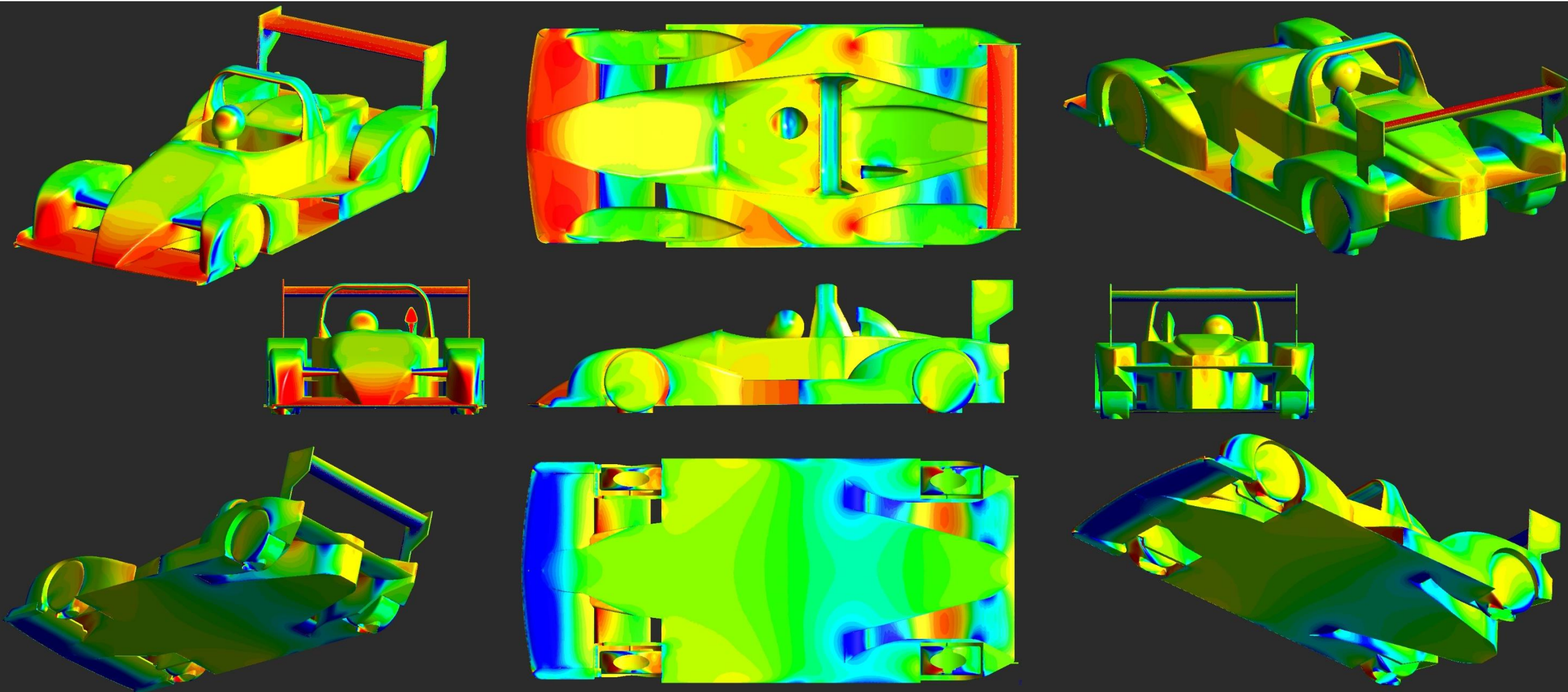
	Downforce (N)	Drag (N)	Balance (%Front)	Efficiency (Lift/Drag)
Baseline	384	458	44.08	0.84
Final Design	2002	545	49.4	3.68
Delta	+1621 (422%)	+90 (19%)	5.34%	+2.835 (336%)

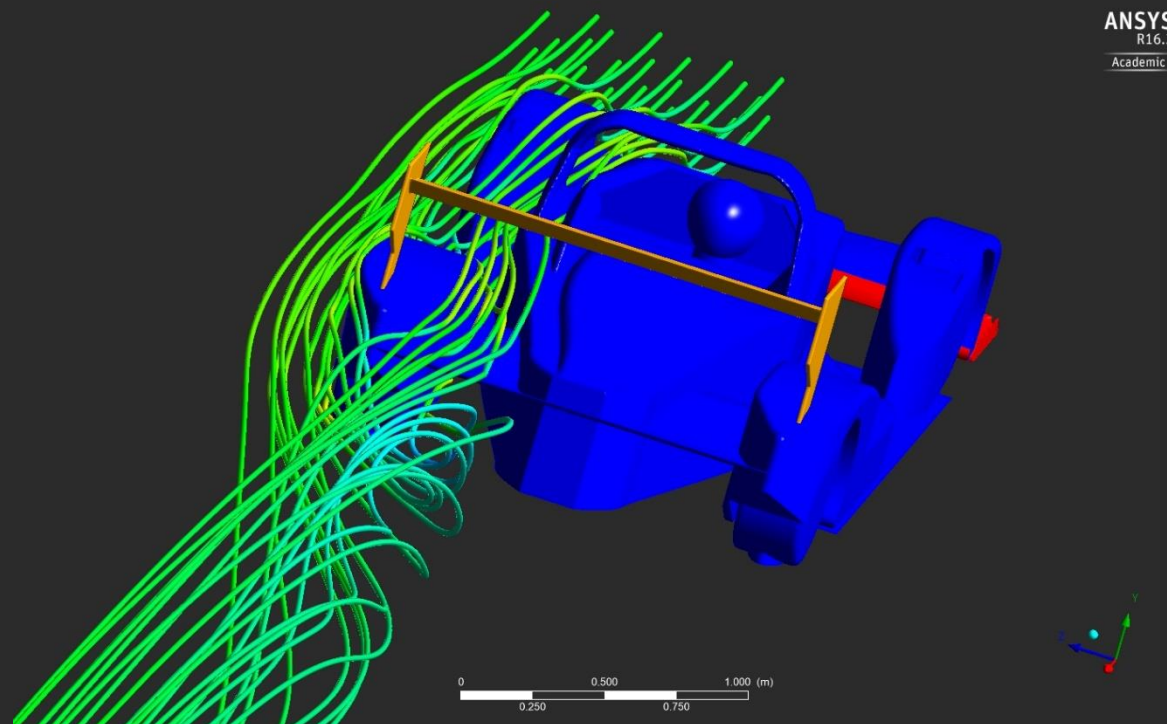
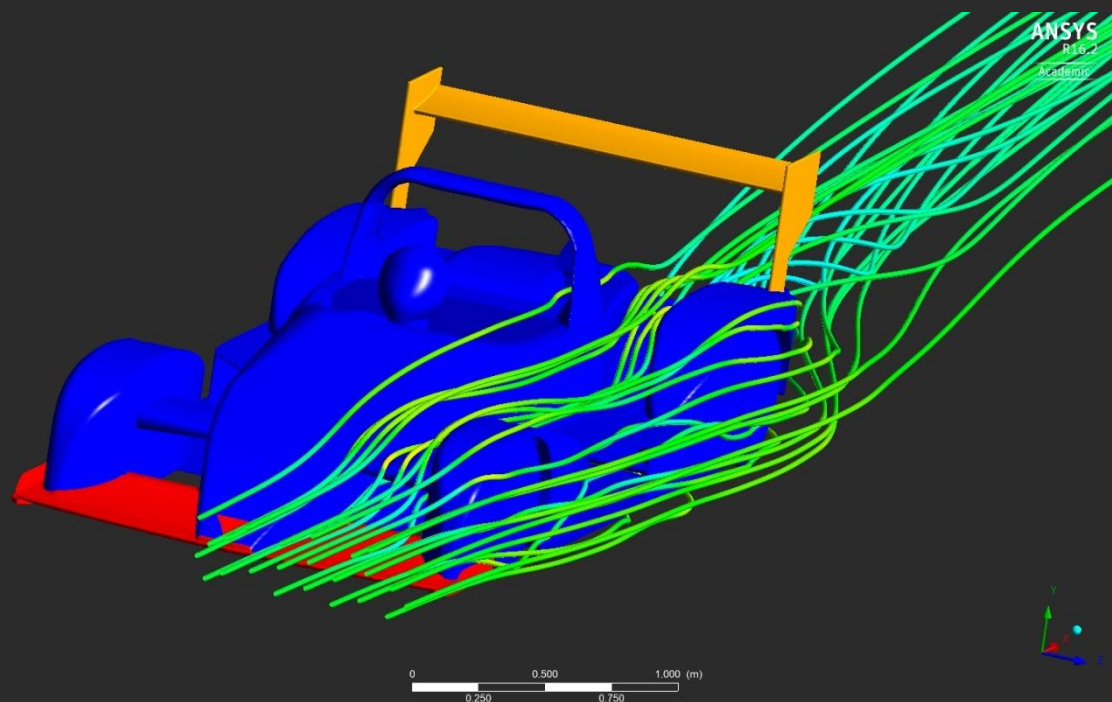


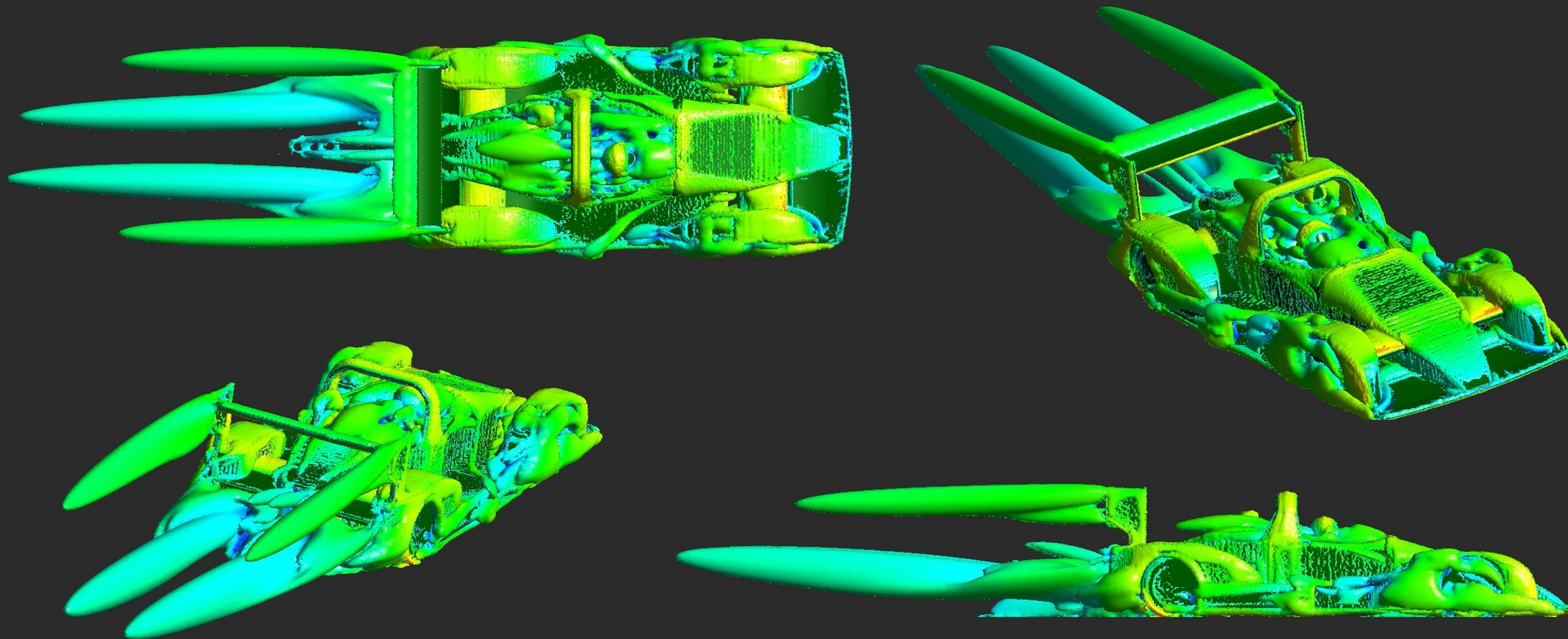




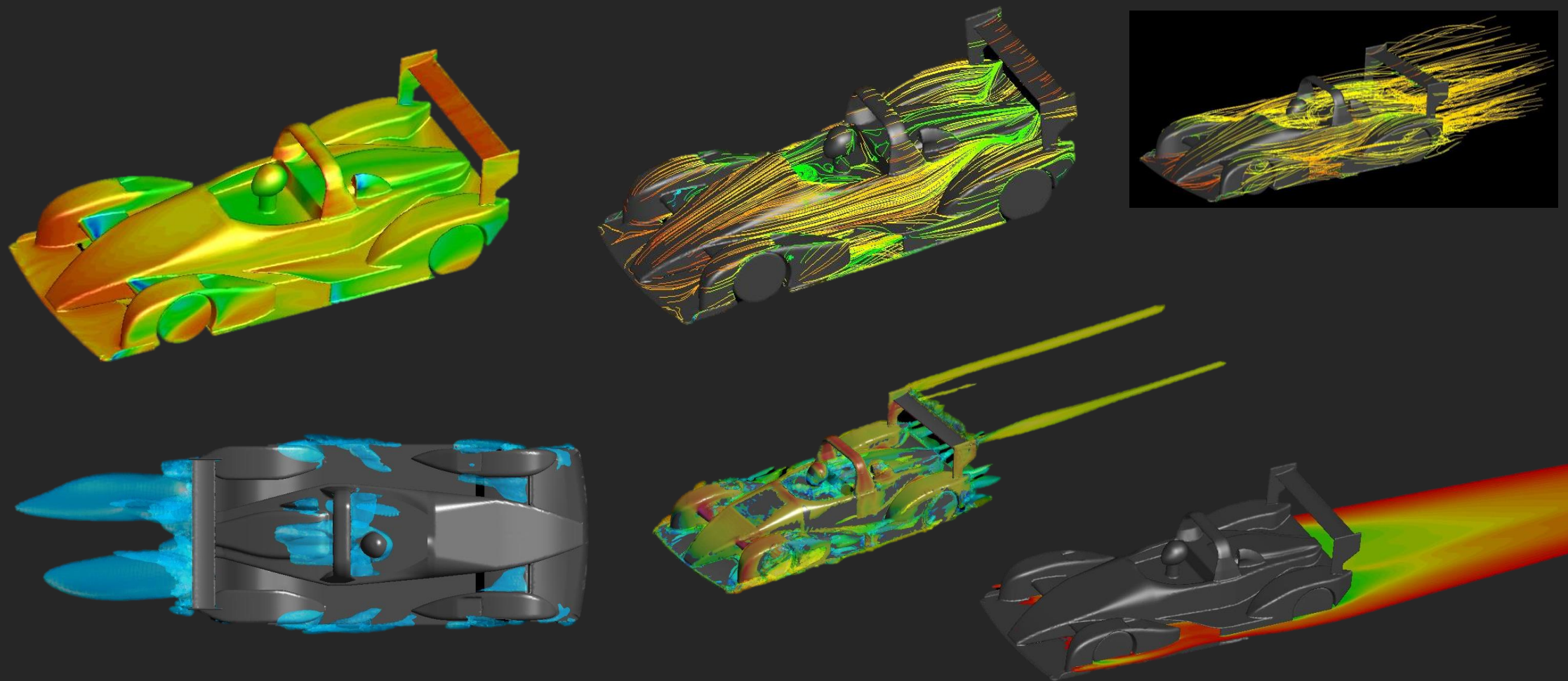


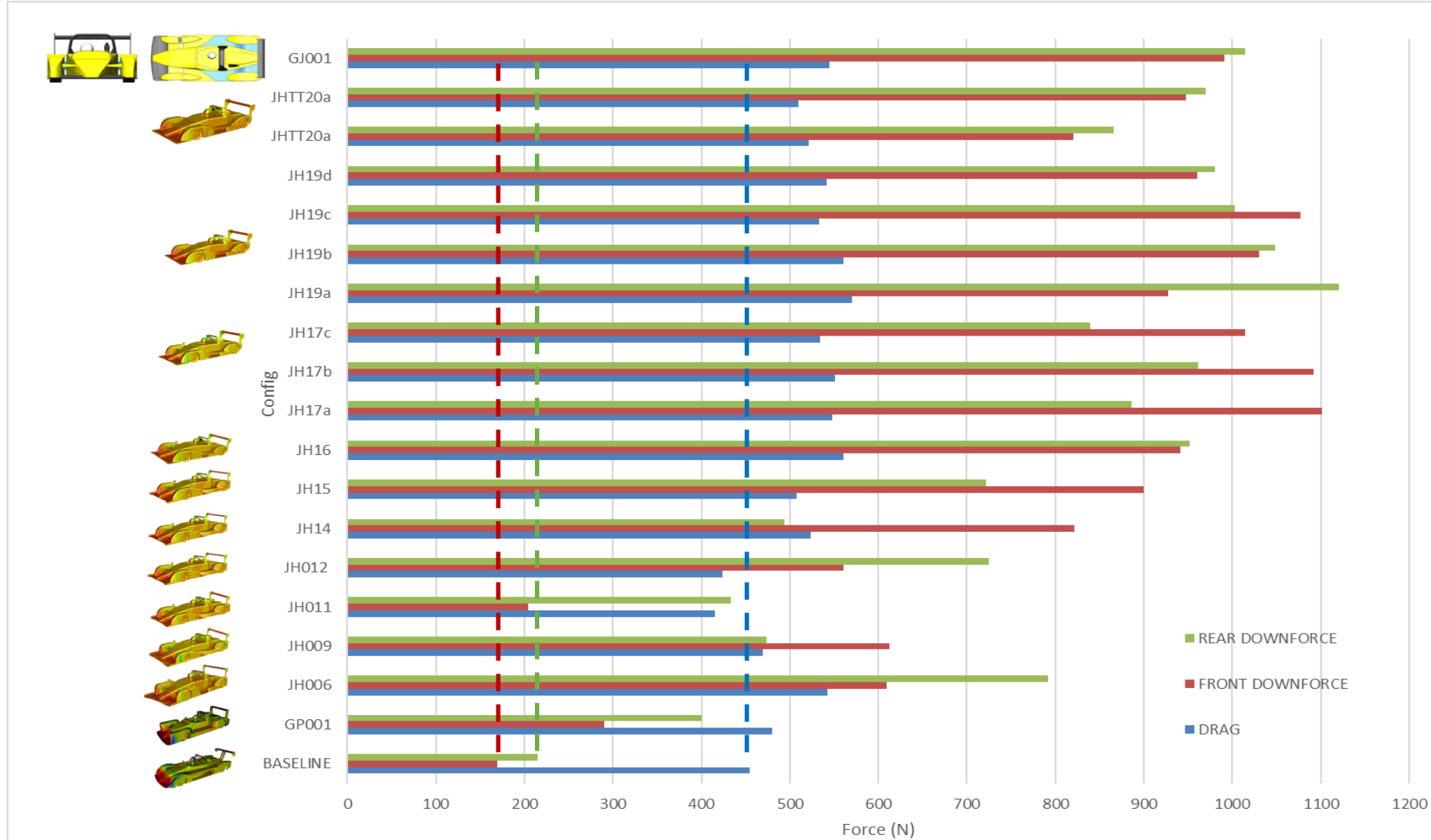




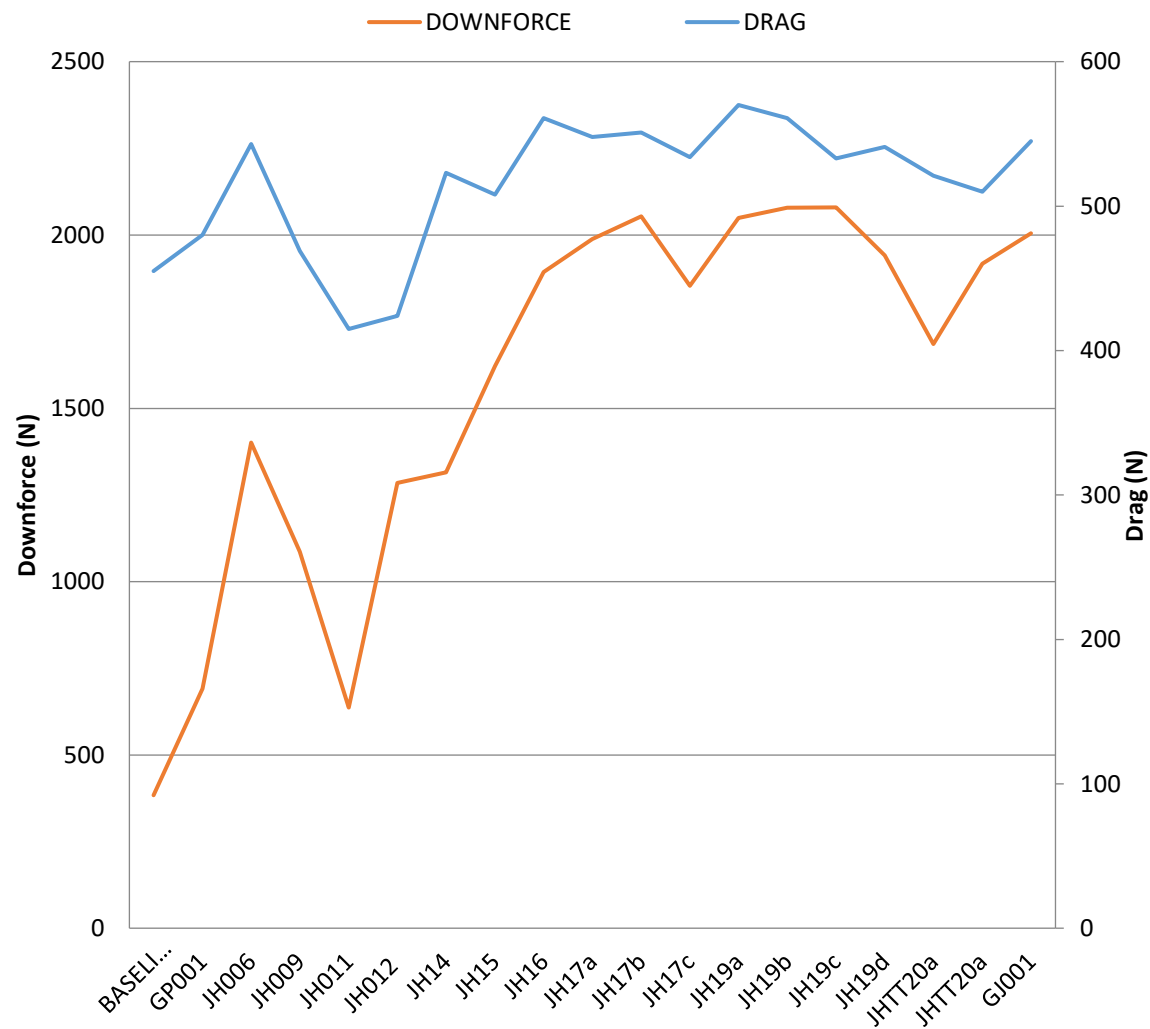


Postprocessing

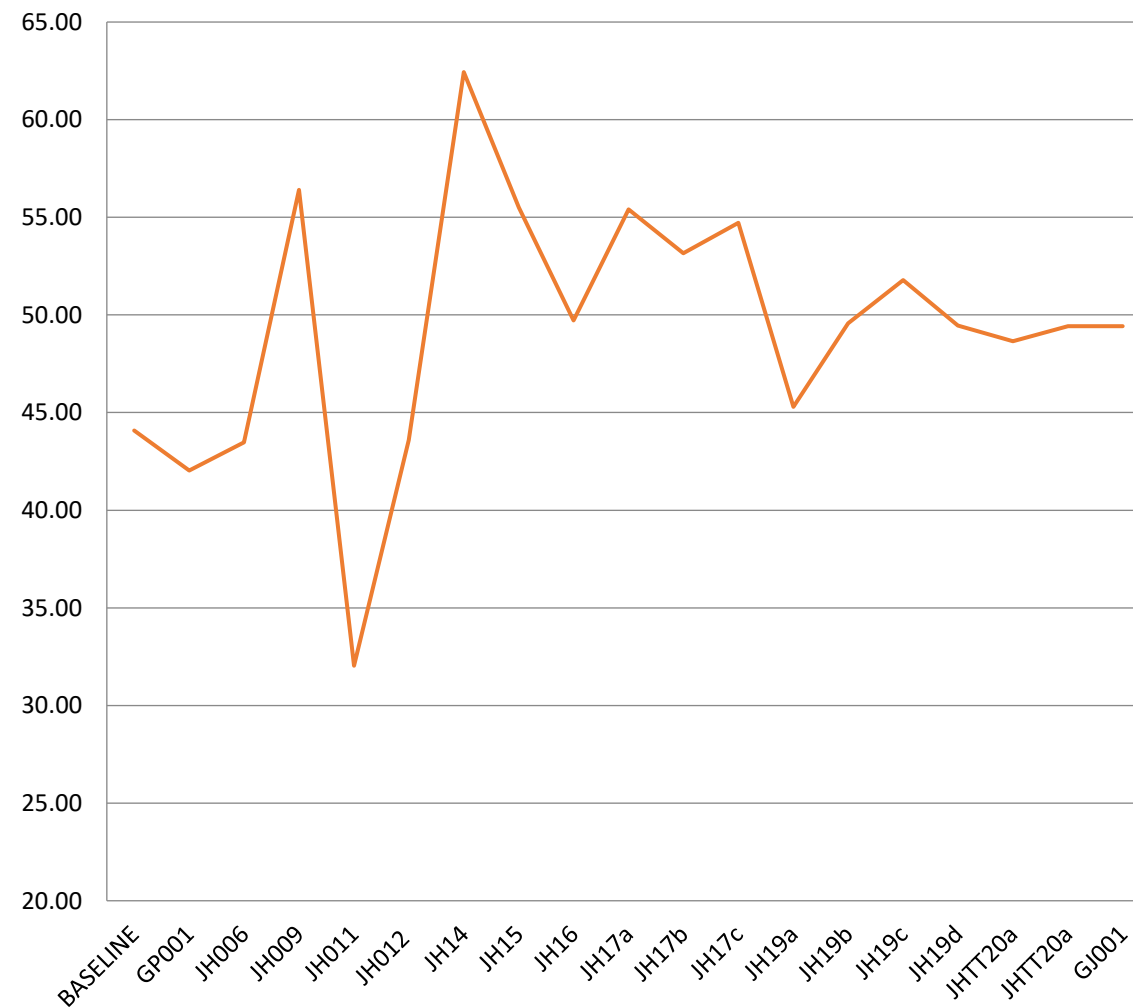




Development : Forces

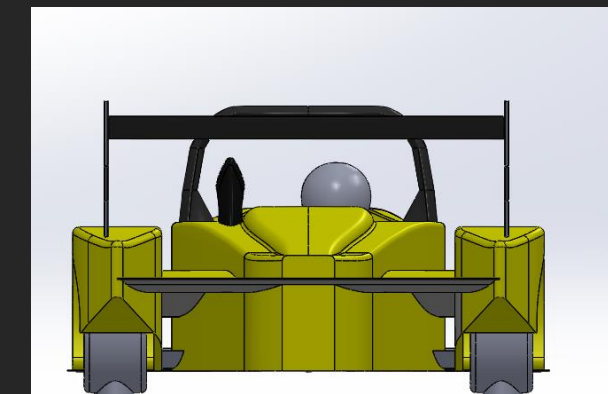
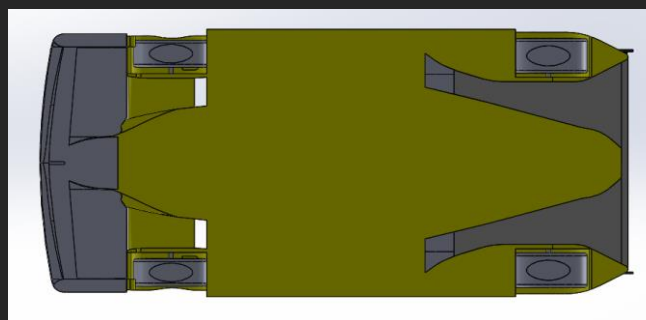
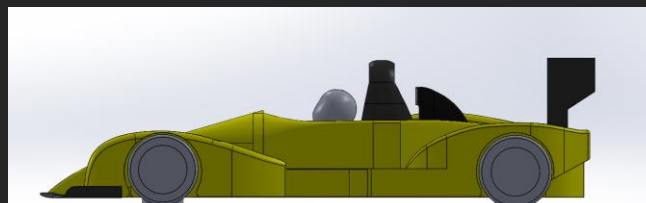
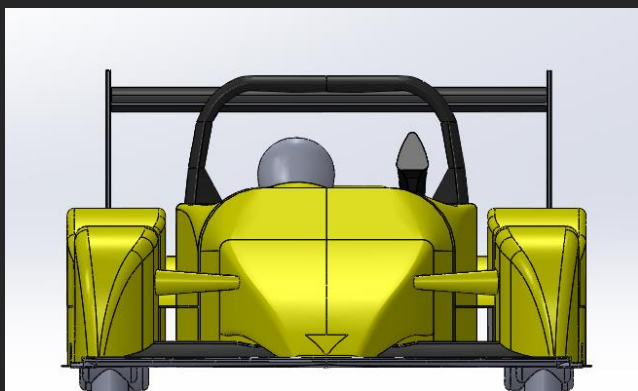
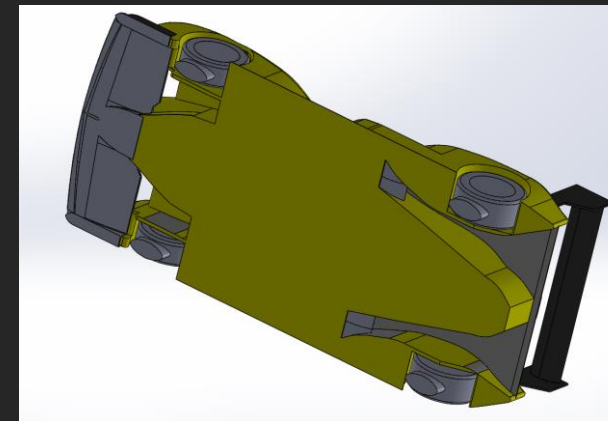
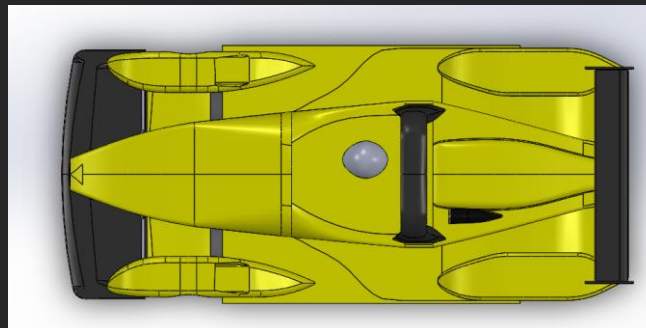
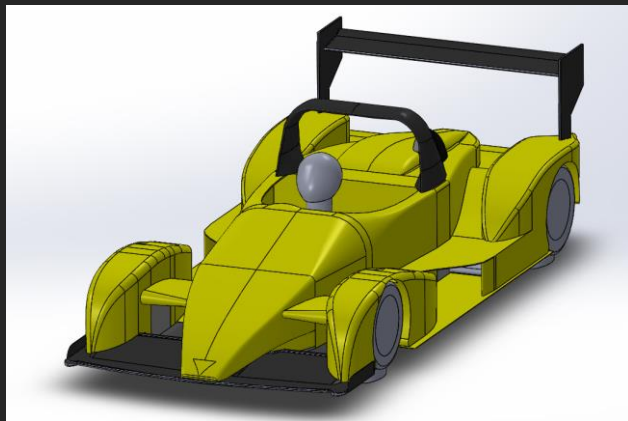


Development : Balance (% Front)



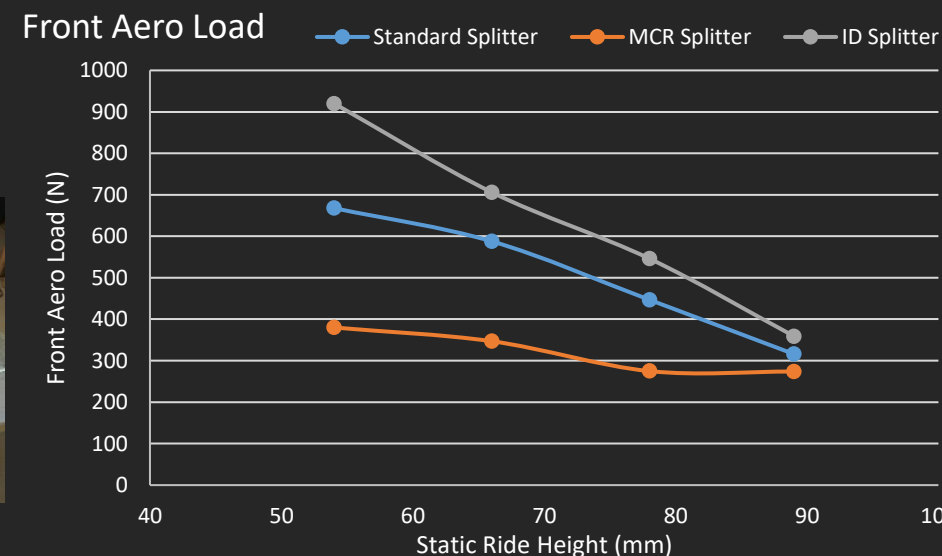
Final Design

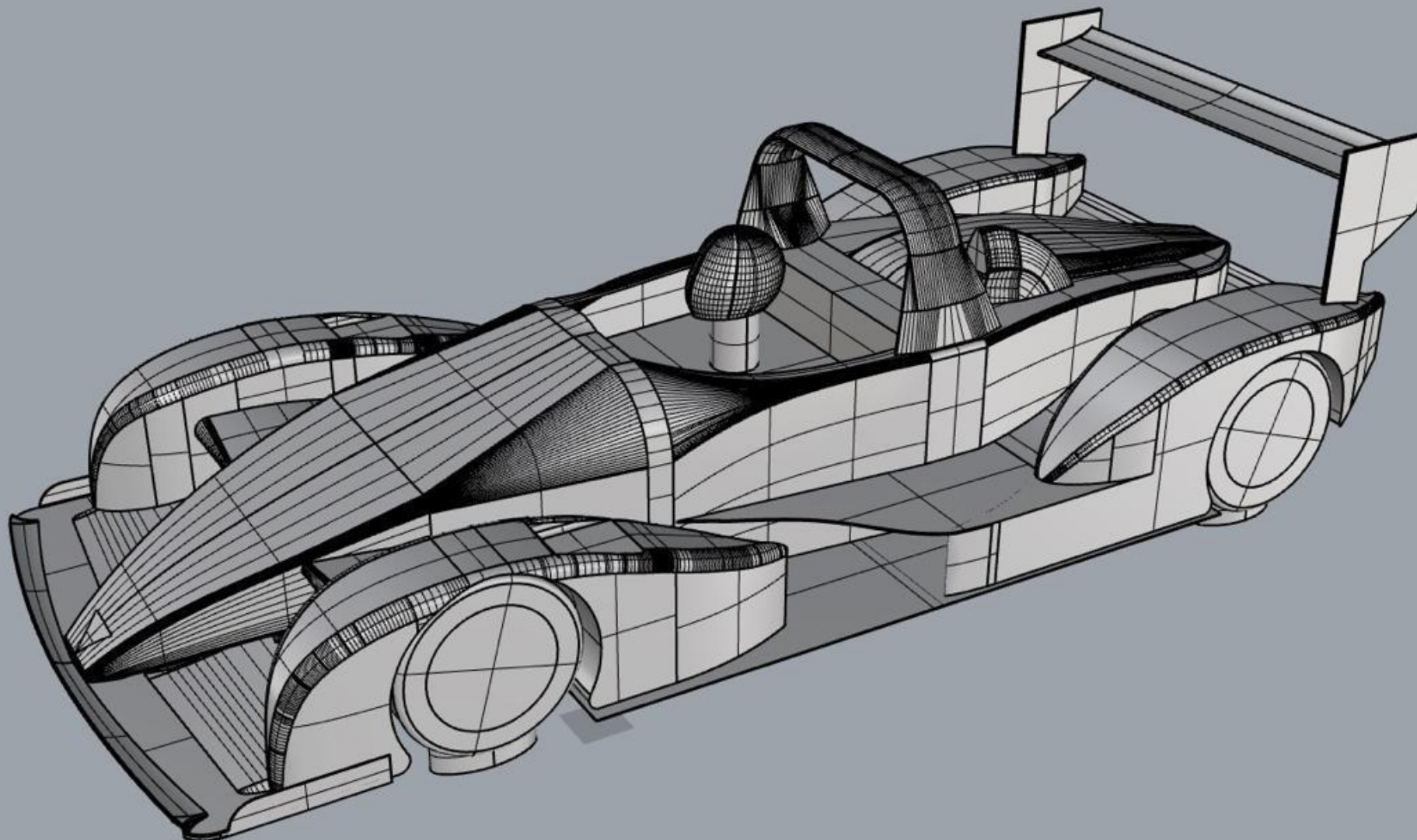
- Final Design ready for manufacture



Splitter Manufacture & Test

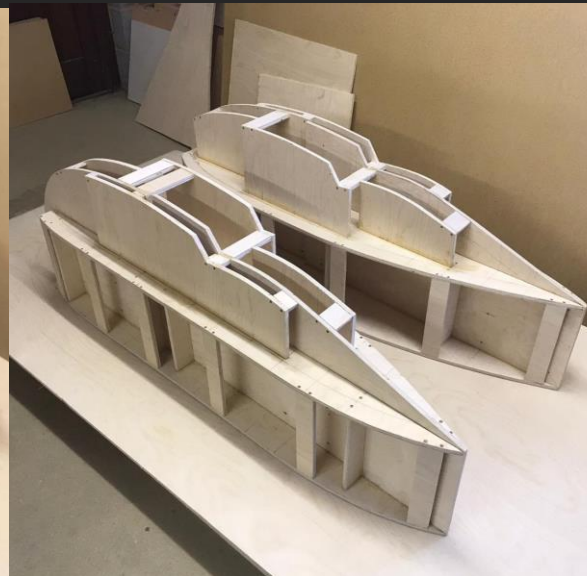
- Iley Design Produced Splitter Prototype to UWTSD Design
- 2 Week Manufacture to prototype
- Tested on car
- Results match CFD predictions and yield significant improvement
- Project work flow proven





Buck Production

- Iley Design commissioned to produce full size pattern (buck) of the bodywork package
- Skeleton constructed from Plywood measured to the CAD model supplied



Buck Production

- Splitter pattern also produced
- Splitter integration with bodywork pattern developed



Skeleton



Front Pontoons



Rear Pontoons, Nose, Centre Section

- Foam bonded for radii
- Flexible Ply Skins added



Centre Section

- Central Section Skinned with Flexible Ply
- Sidepods and upper deck manufactured





Detail Radii & Filling



Sanding

- Foam skimmed with filler and sanded



Primer Filler

- Buck Coated with Primer Filler and sanded



Finishing & Collection

- Surface finish sanding and final collection



Buck Assembly + Finishing (MCR)



Nose Stiffness Modification



Splitline Preparation



Preparation of Moulds



Moulds



Buck Assembly + Finishing (MCR)



Prototype Bodywork



Prototype Bodywork



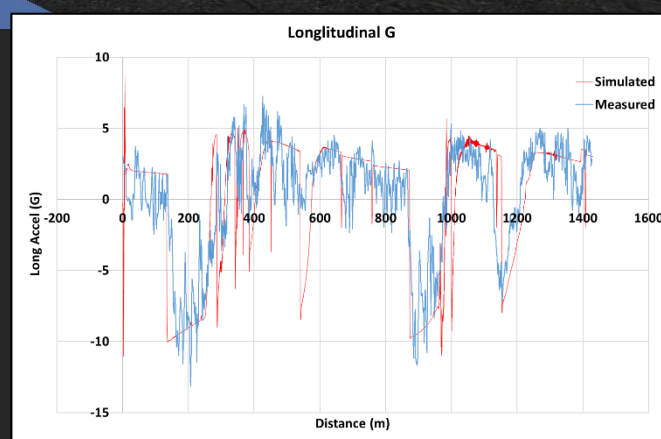
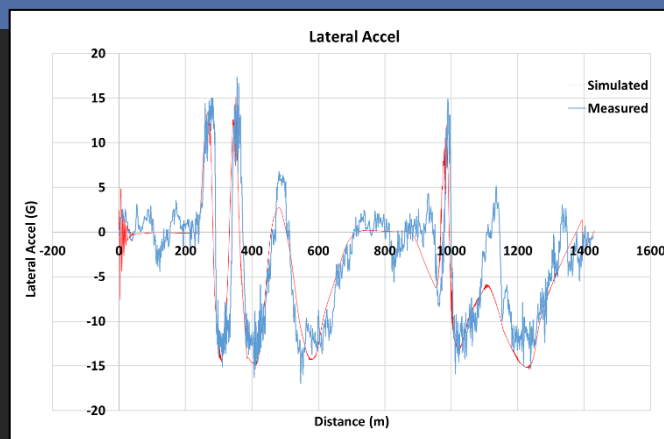
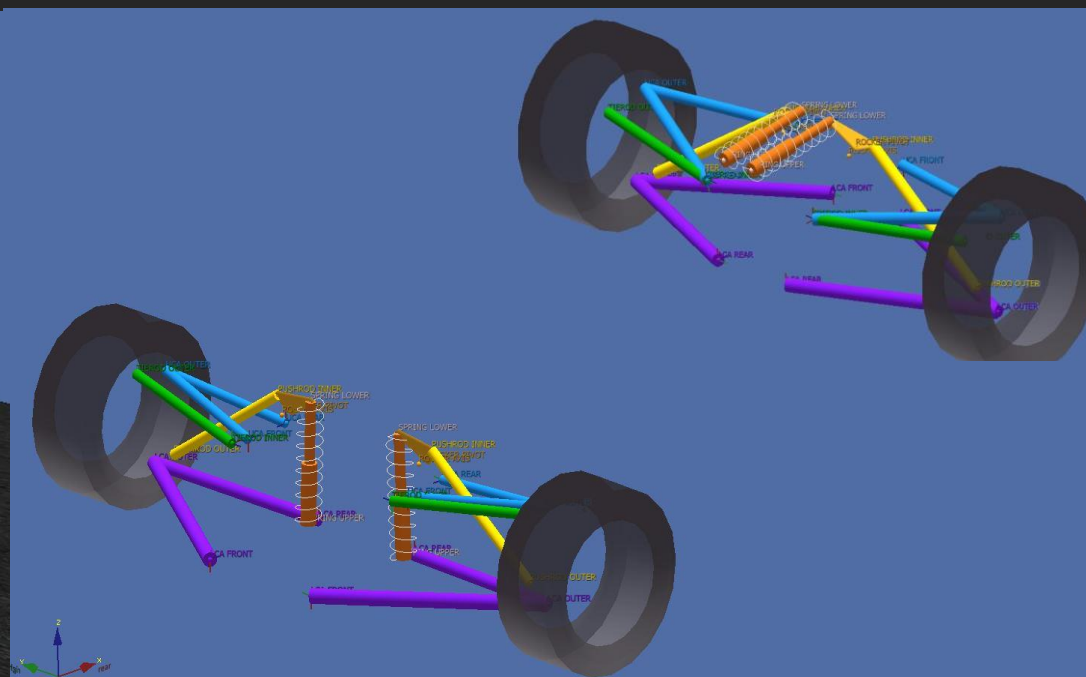
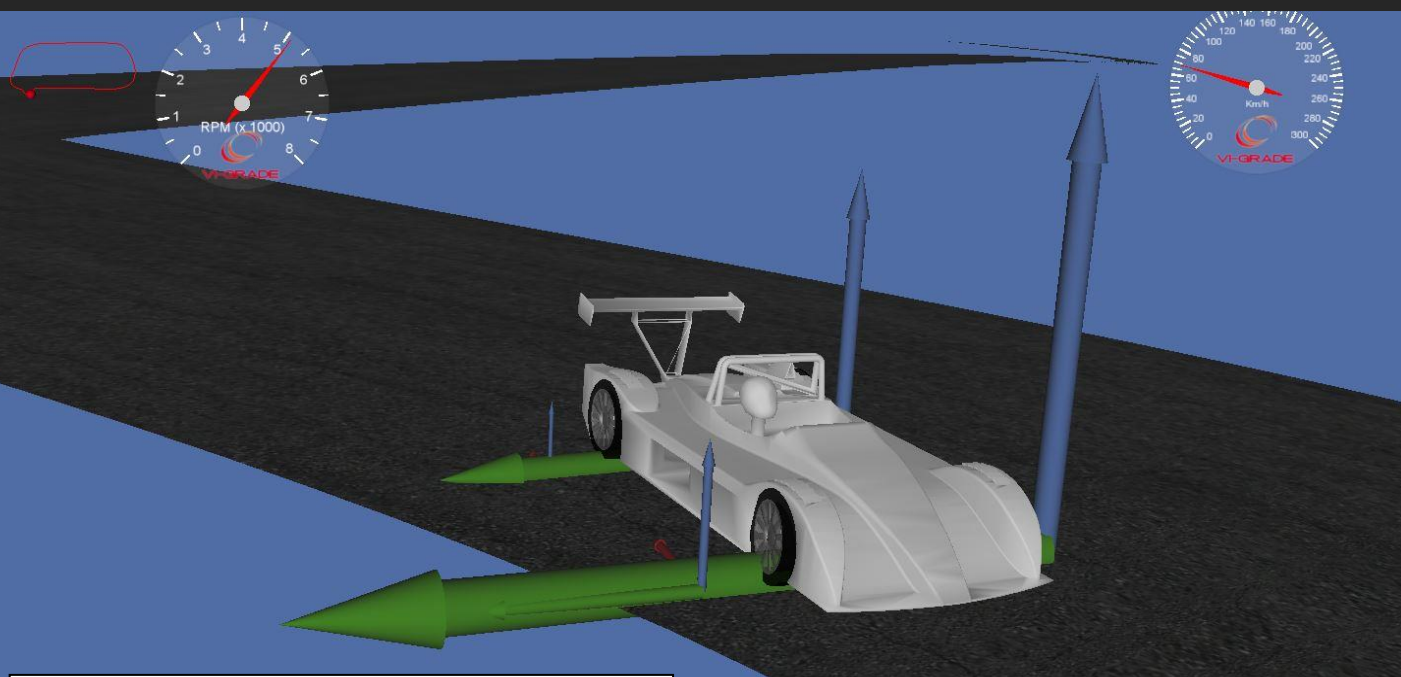
Prototype Bodywork

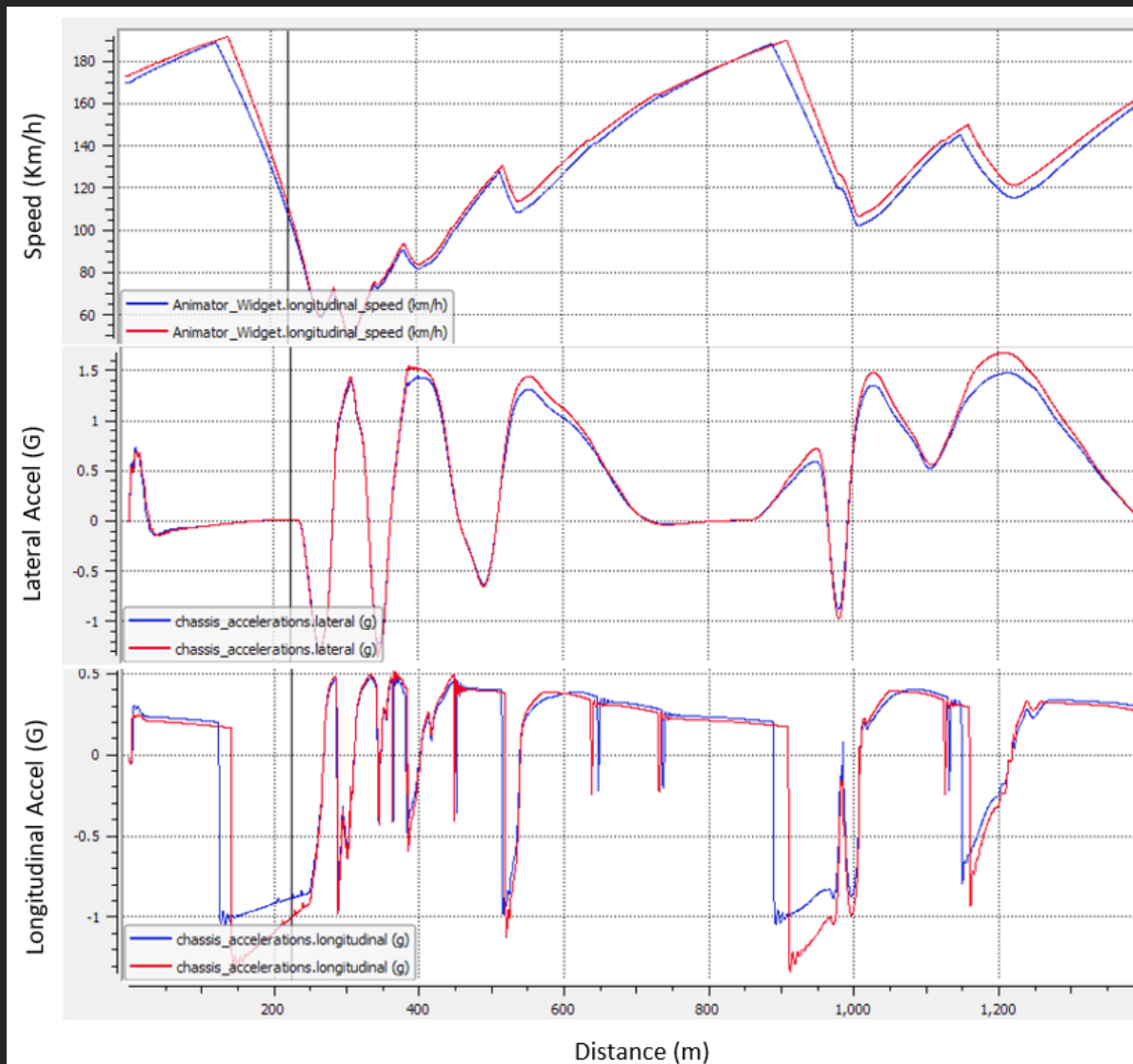
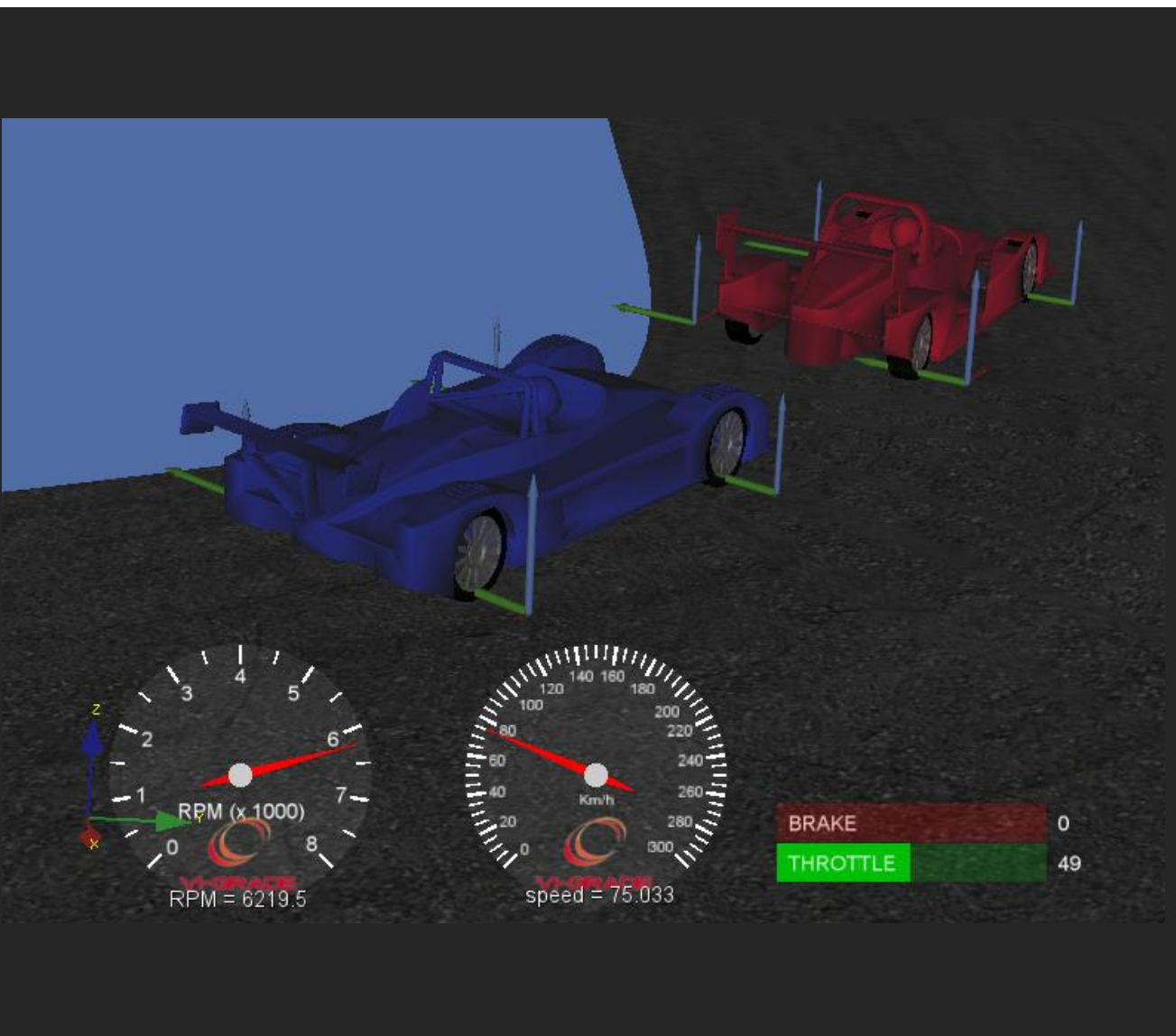


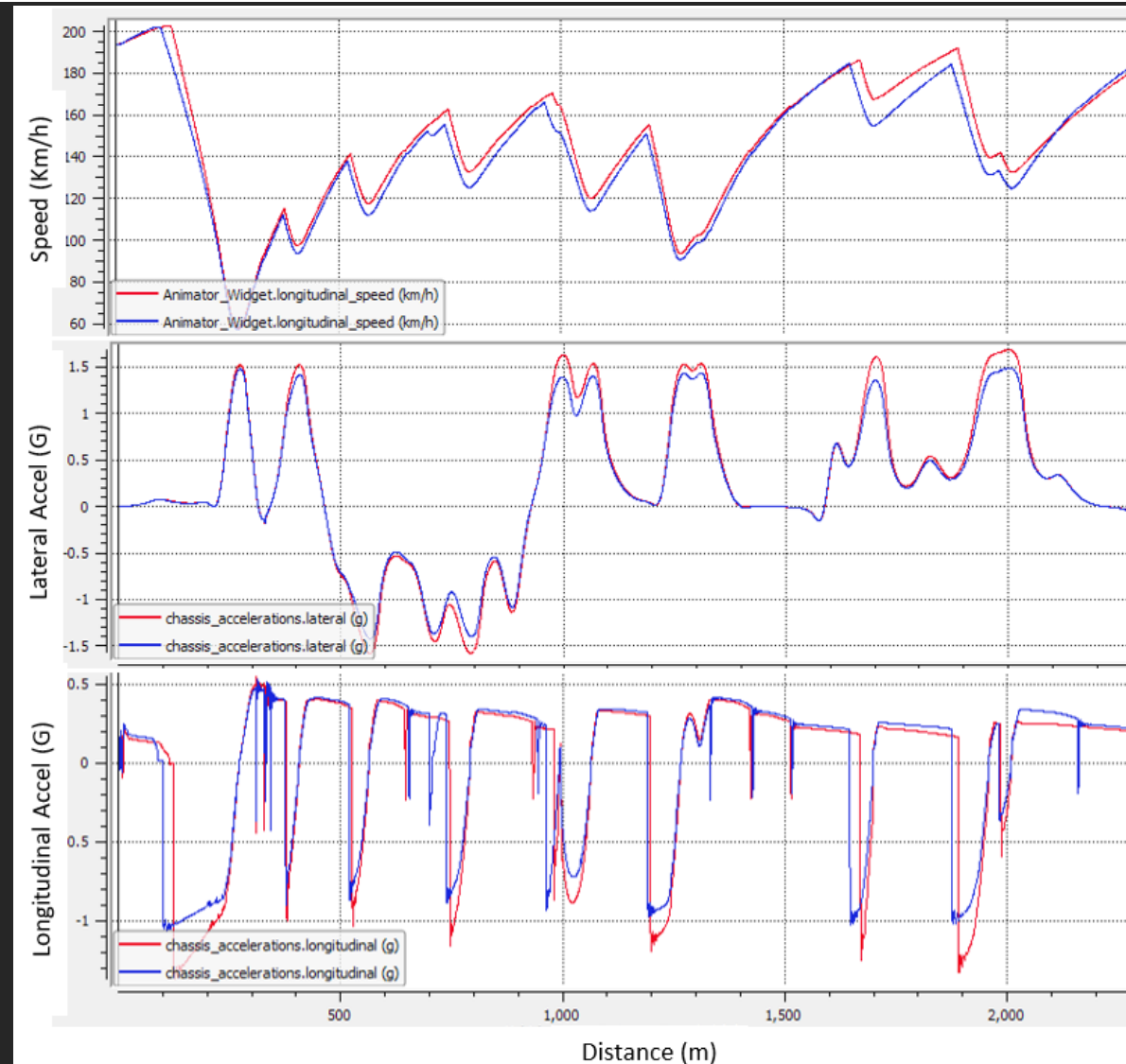
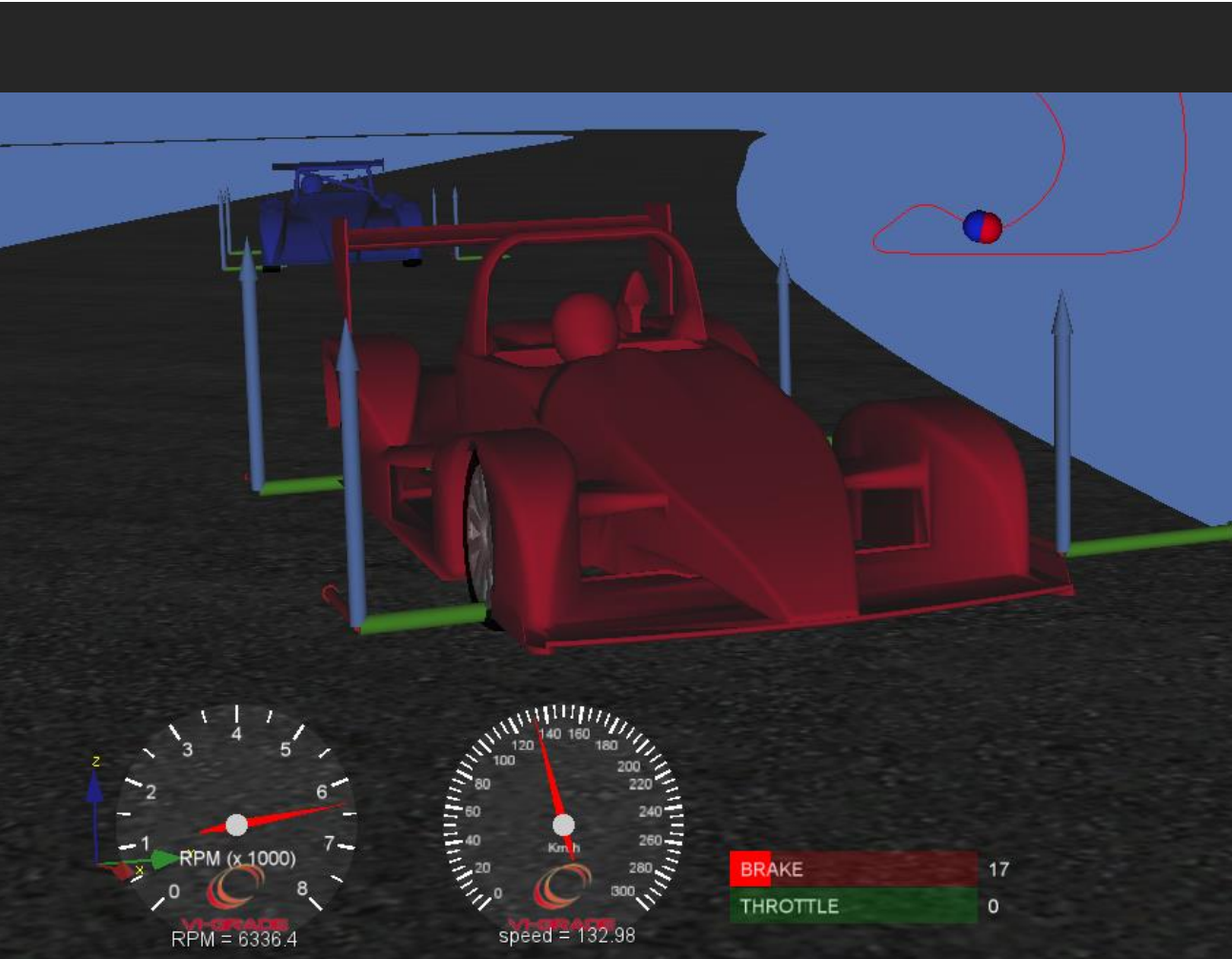


Prototype Bodywork











Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David



TRACK DEBUT





Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

ILEY
DESIGN



TRACK DEBUT



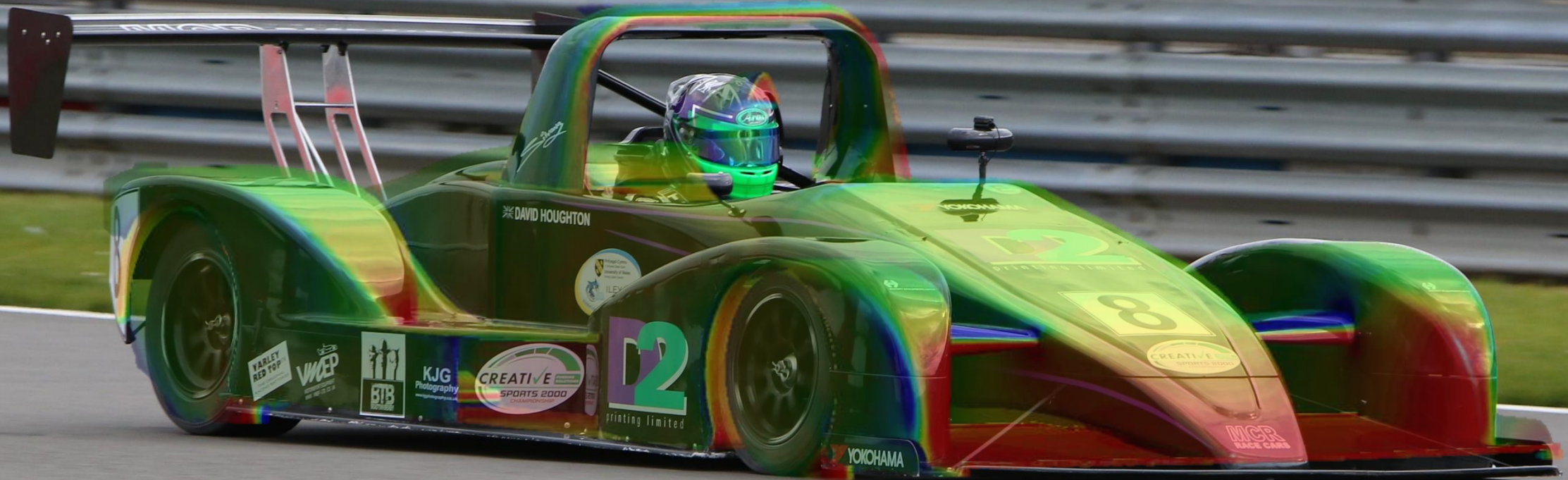


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TRACK DEBUT





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University of Wales
Trinity Saint David





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Y Drindod Dewi Sant
University of Wales
Trinity Saint David



Production Bodywork

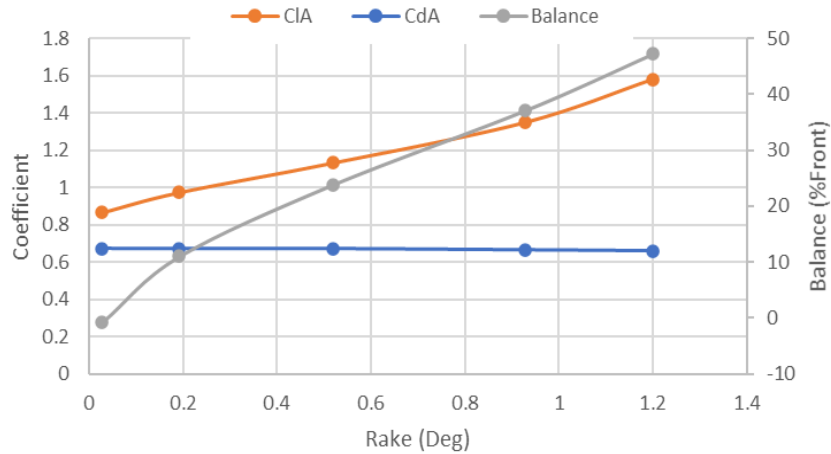


Windtunnel Testing

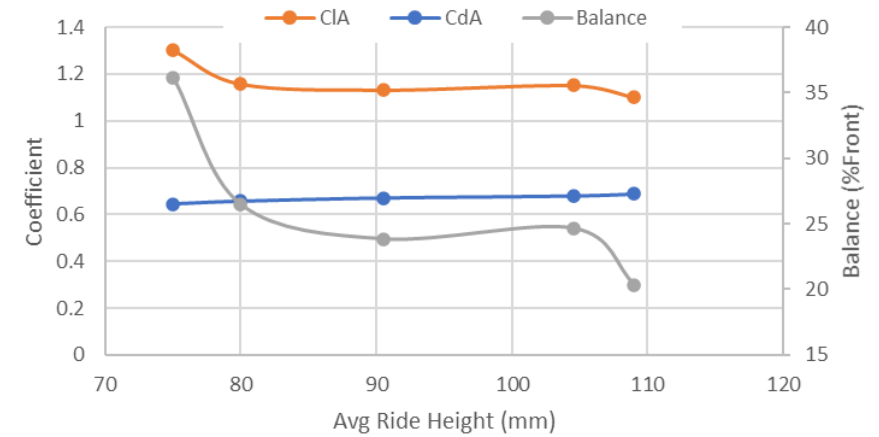


Windtunnel Results

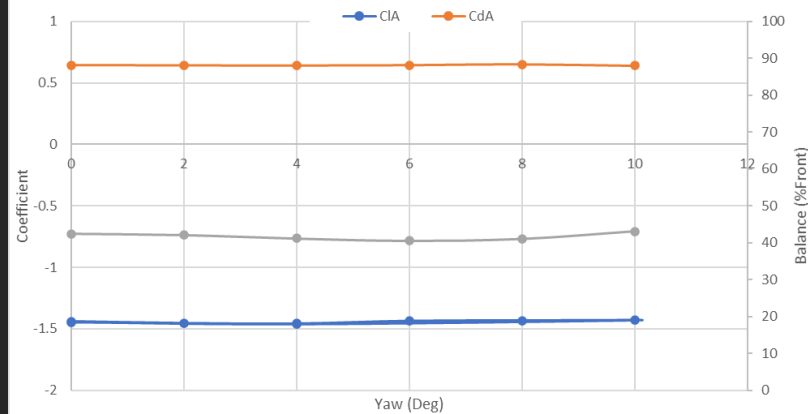
Rake Study (Front RH=42mm)



Ride Study



Yaw Study

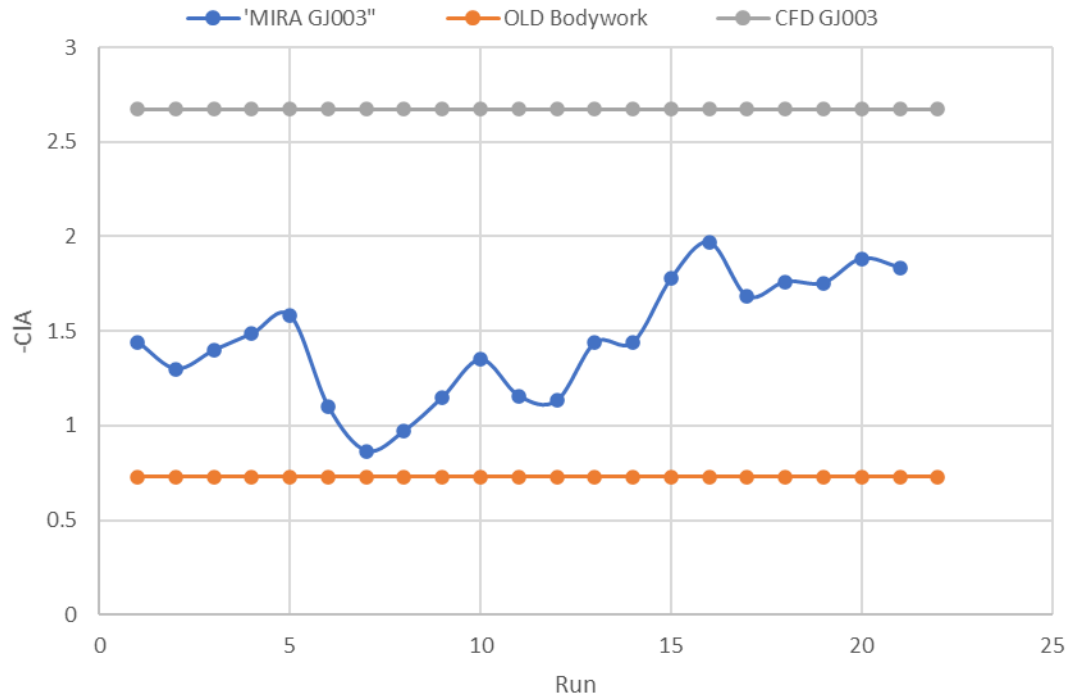


Windtunnel Smoke

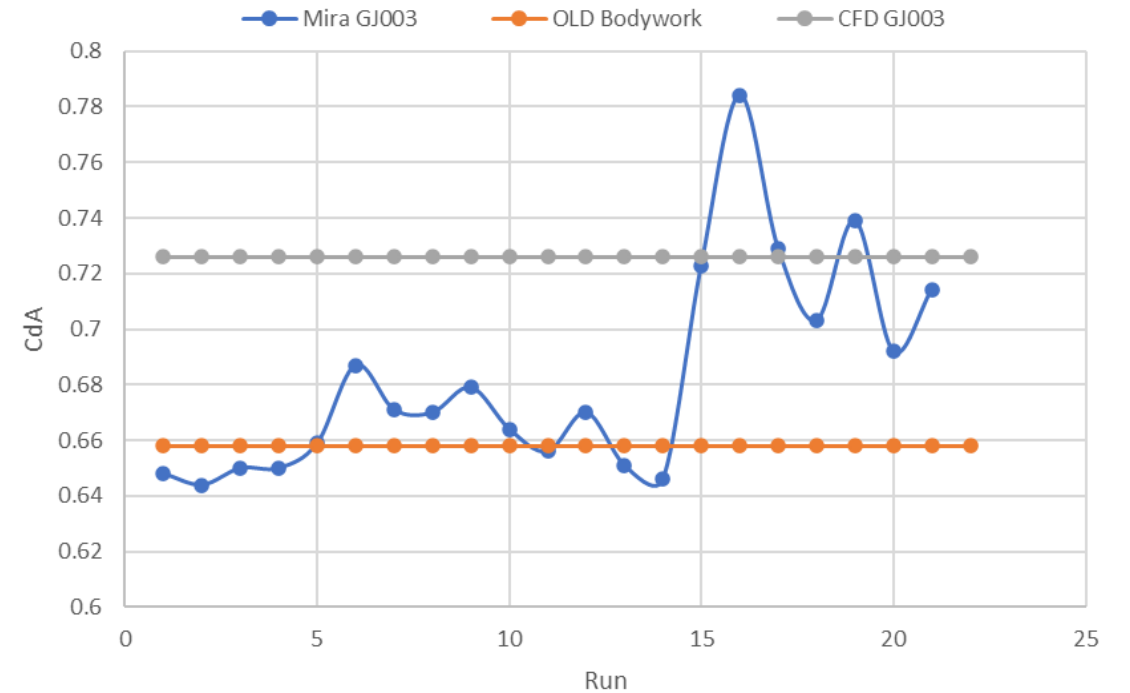


Windtunnel Results

Downforce Vs RUN



Drag Vs RUN



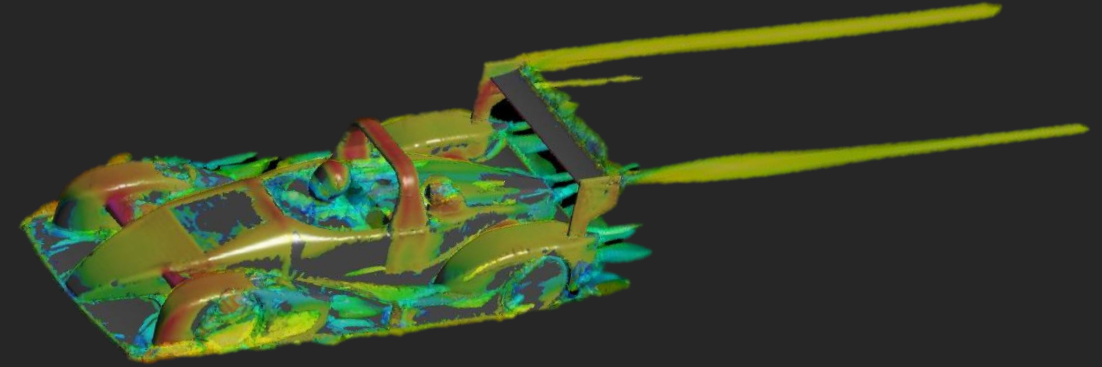
	DRAG	DOWNFORCE	EFFICIENCY	BALANCE (% Front)	FRONT DOWNFORCE	REAR DOWNFORCE	Cd	CI	Clf	Clr
MIRA BASELINE	519	571	1.100	19.07	108.87	462.13	0.658	0.729	0.139	0.589
MIRA WORKS MCR	541	893	1.651	34.24	305.76	587.34	0.689	1.145	0.392	0.754
CFD BASELINE	455	384	0.844	44.08	169.26	214.74	0.606	0.512	0.226	0.286
CFD GJ003 BASELINE	545	2005	3.679	49.42	990.89	1014.11	0.726	2.672	1.321	1.352
MIRA GJ003 BASELINE	486.9	1048.0	2.15	40.24	421.74	626.24	0.65	1.399	0.563	0.836
MIRA GJ003 BEST	518.4	1409.8	2.72	41.18	580.54	831.94	0.692	1.882	0.775	1.1106



Conclusion : Project Success

Key Outcomes

- Downforce increased by factor of 2
- Drag increase minimised
- Aerodynamic Efficiency Doubled
- Balance improved by bringing CoP forward
- CFD Approach and method proven
- Track results and driver feedback all positive
- Project succeeded to meet initial objectives



@35m/s	Downforce (N)	Drag (N)	Balance (%Front)	Efficiency (Lift/Drag)
Baseline	571	519	20	1.1
UWTSD Bodywork	1409	518.4	41.2	2.72
Delta	+838 (246%)	-0.6 (0.1%)	+21.2	+1.62 (247%)

Conclusion : Project Success

Key Outcomes

- MCR Commercially supplying UWTSD (S2n) Bodywork
- Both UWTSD cars sporting the UWTSD S2n Bodywork
- **2022 Championship won with new bodywork (Josh Law)**
 - Won 10/13 Races
 - 8 Fastest Laps
- 7 UWTSD Bodywork cars on grid
- 24 Cars on grid, 18 MCRS
- 2023 will see >10 S2ns on the Grid

