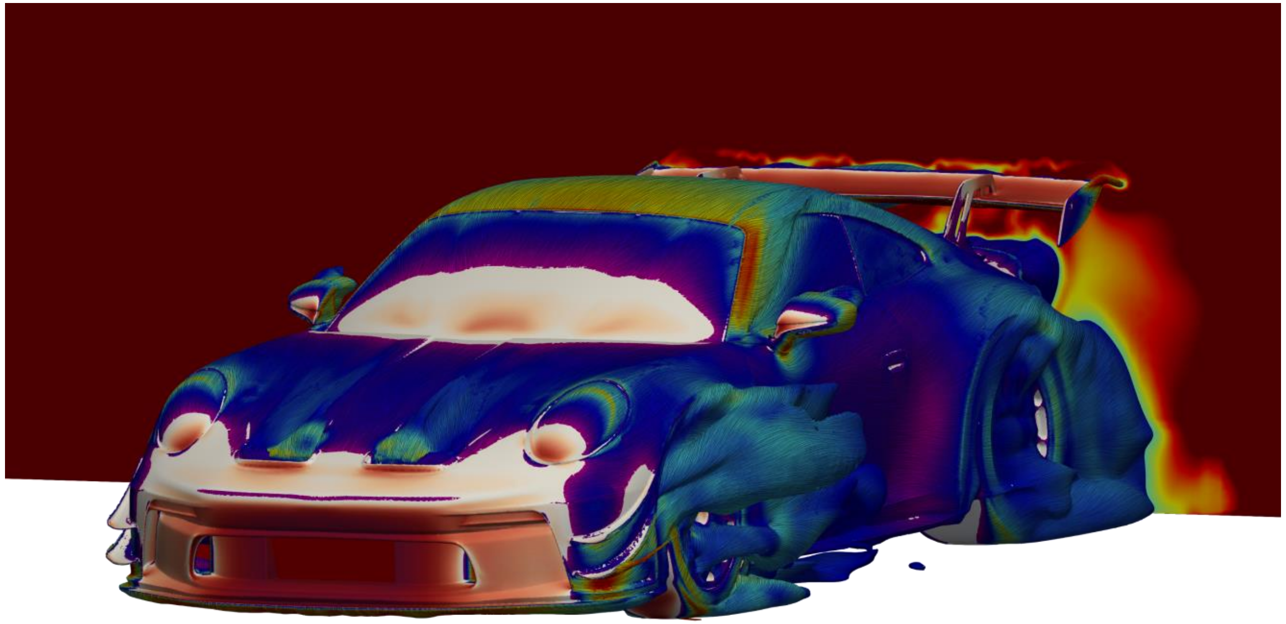
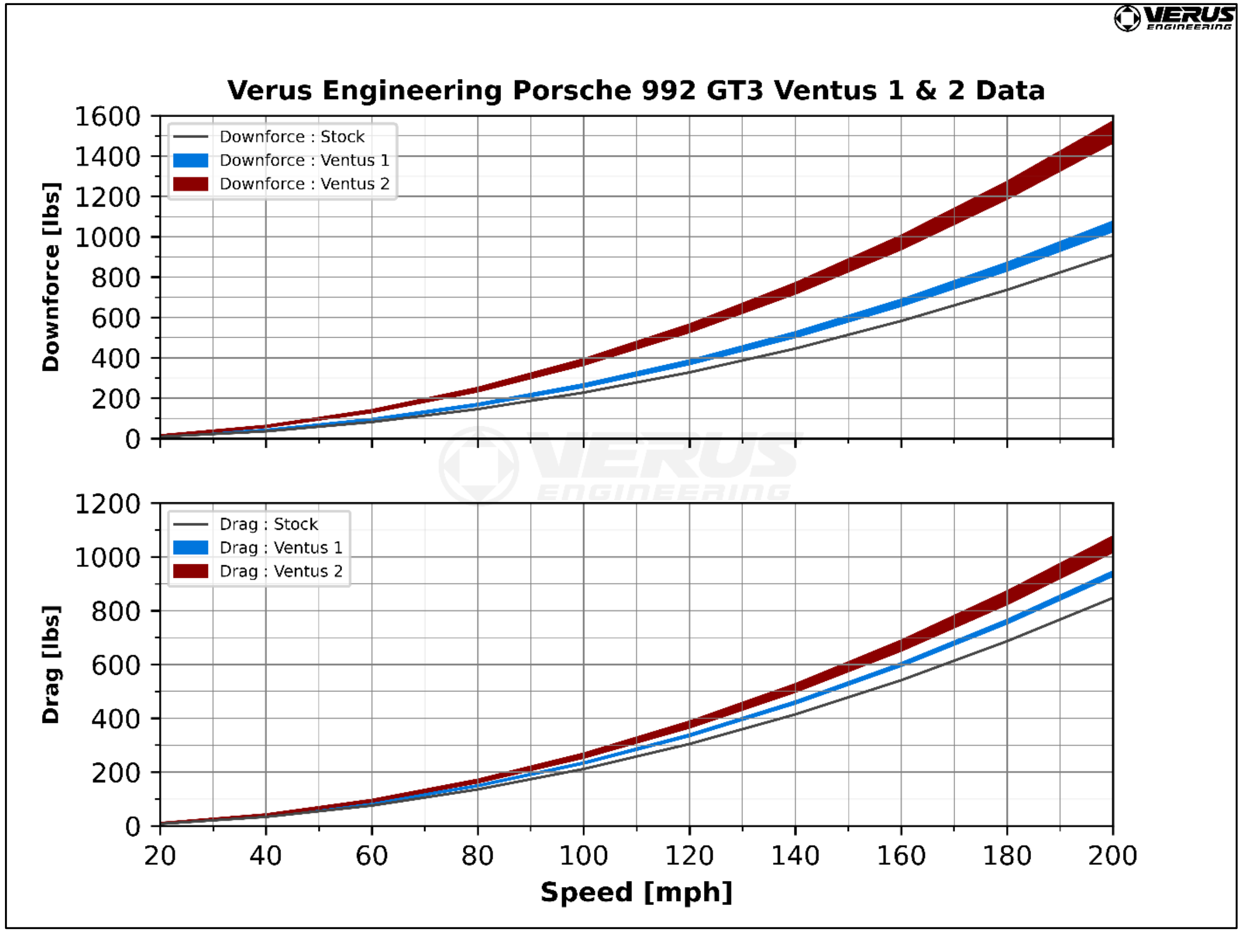


PORSCHE 992 GT3

PERFORMANCE OF VERUS ENGINEERING'S VENTUS 1&2 PACKAGES

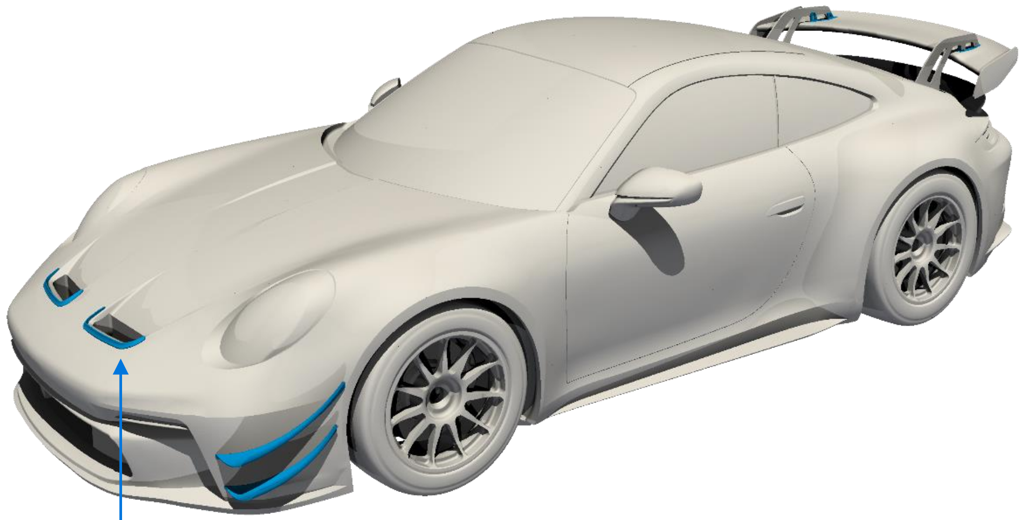
SUMMARY : AERODYNAMIC FORCES

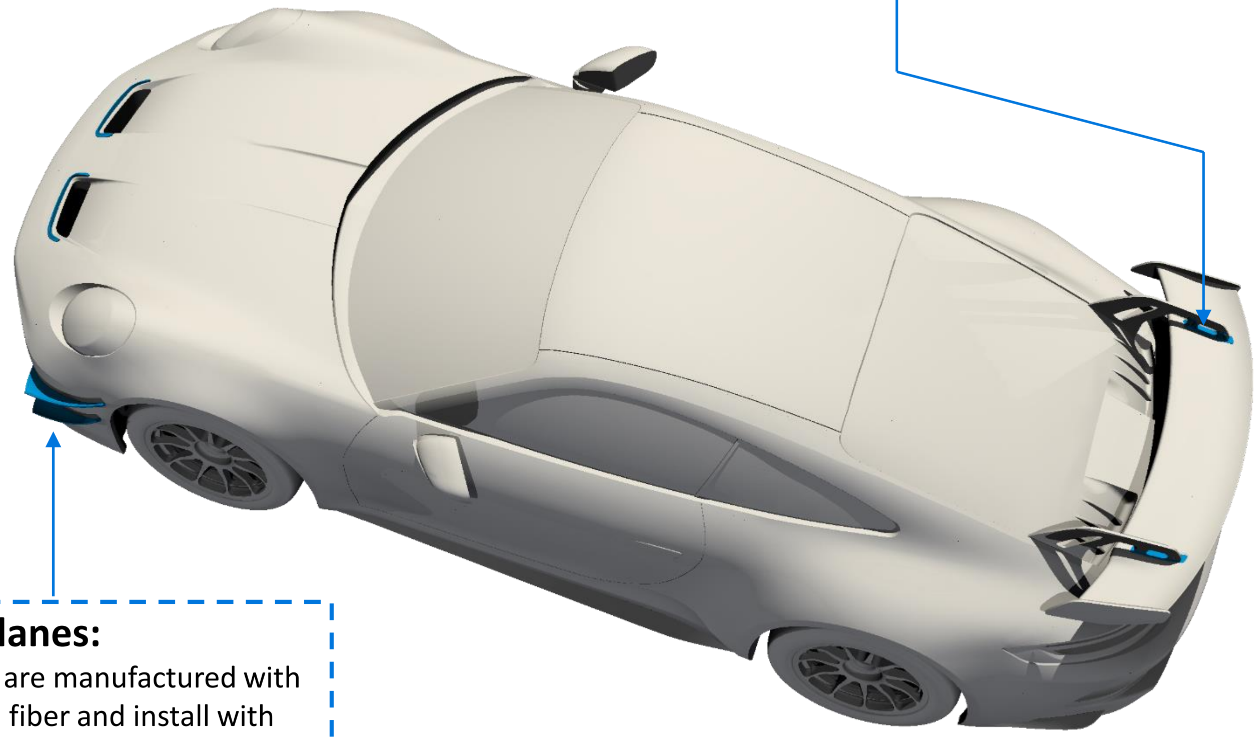
- Aerodynamic forces change with the square of the vehicle speed, which is why we use a graph.
- The Ventus 1 & 2 packages increases downforce over stock with minimal impact to drag.
- The lower value on the Ventus 1 wing at factory setting, while the higher value is with the wing with 4 additional degrees.
- The lower value on the Ventus 2 UCW wing at 6 degrees, while the higher value is with the wing at 12 degrees.
- AOA adjustment allows the driver to fine tune aerodynamic balance to his or her preference.
- The Ventus kit is designed and tested to make your 992 GT3 faster around the track.



VENTUS 1 PACKAGE

Upgraded Factory Wing Mounts:
The wing mounts are machined in house out of aluminum. It installs just like factory and allows increased AOA



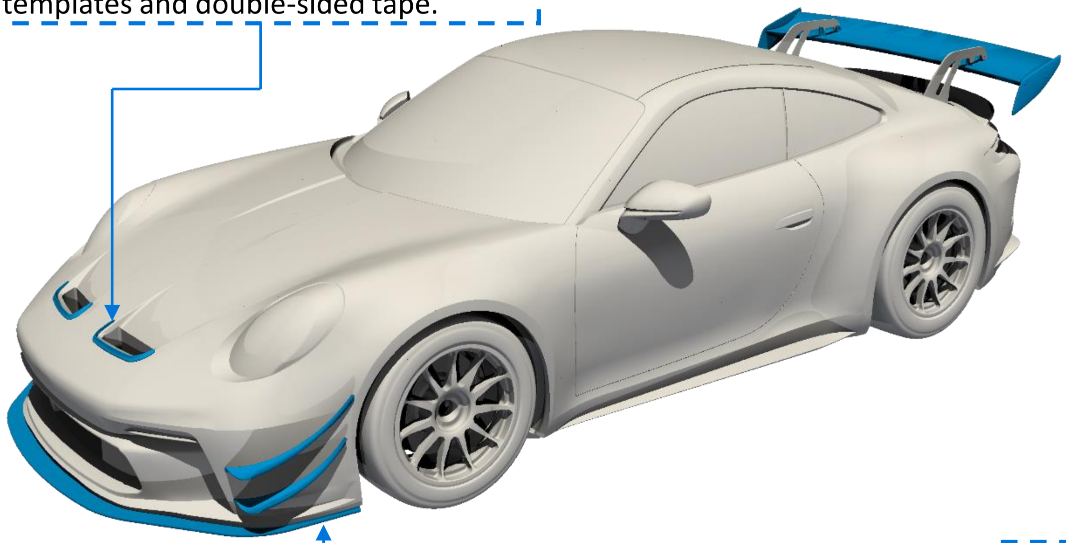


Dual Dive Planes:
The dive planes are manufactured with 2x2 twill carbon fiber and install with templates and double-sided tape.

Radiator Outlet Gurney:
The gurneys are manufactured with 2x2 twill carbon fiber and install with templates and double-sided tape.

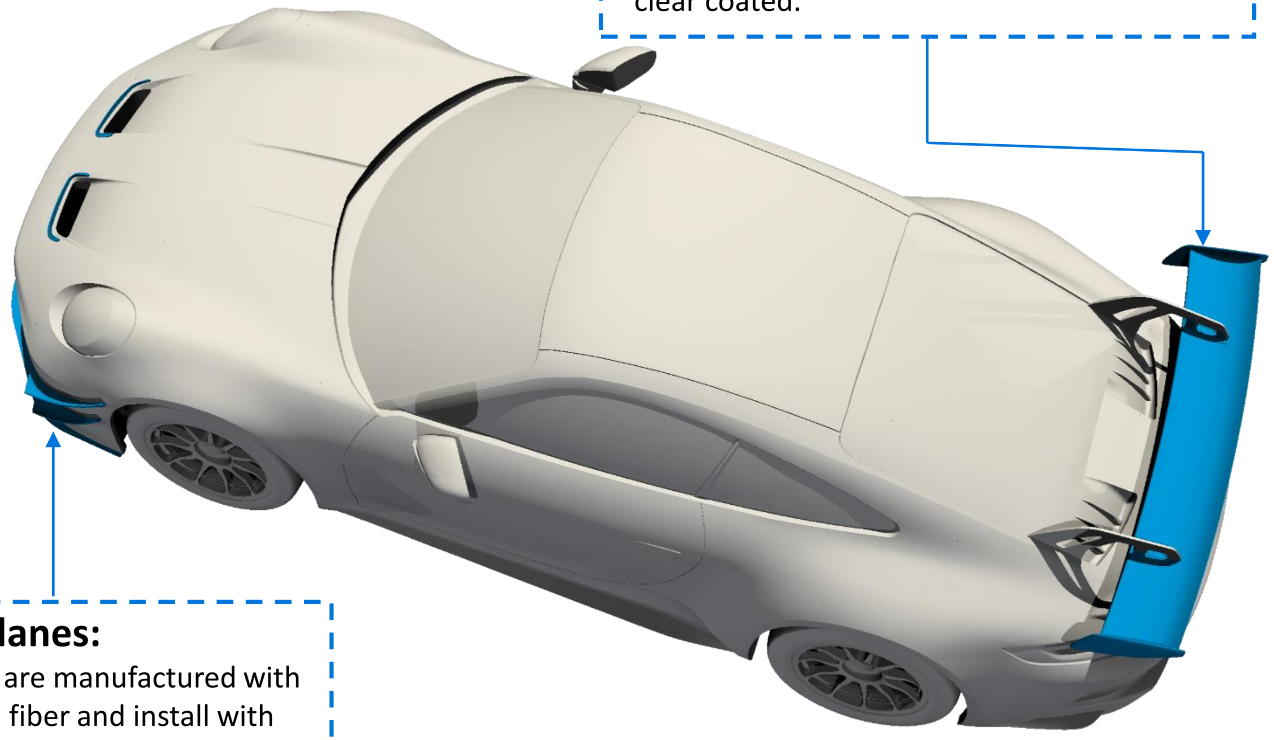
VENTUS 2 PACKAGE

Radiator Outlet Gurney:
The gurneys are manufactured with 2x2 twill carbon fiber and install with templates and double-sided tape.



Splitter:
The splitter blade is manufactured from carbon polyweave which is not as brittle as carbon fiber. This material is perfect for a front splitter. The splitter is mounted to various chassis points and requires no cutting!

UCW WING:
Upgraded wing which utilizes the factory wing uprights. The UCW wing is a large upgrade in performance over the factory Porsche wing. It is manufactured with 2x2 carbon fiber and clear coated.



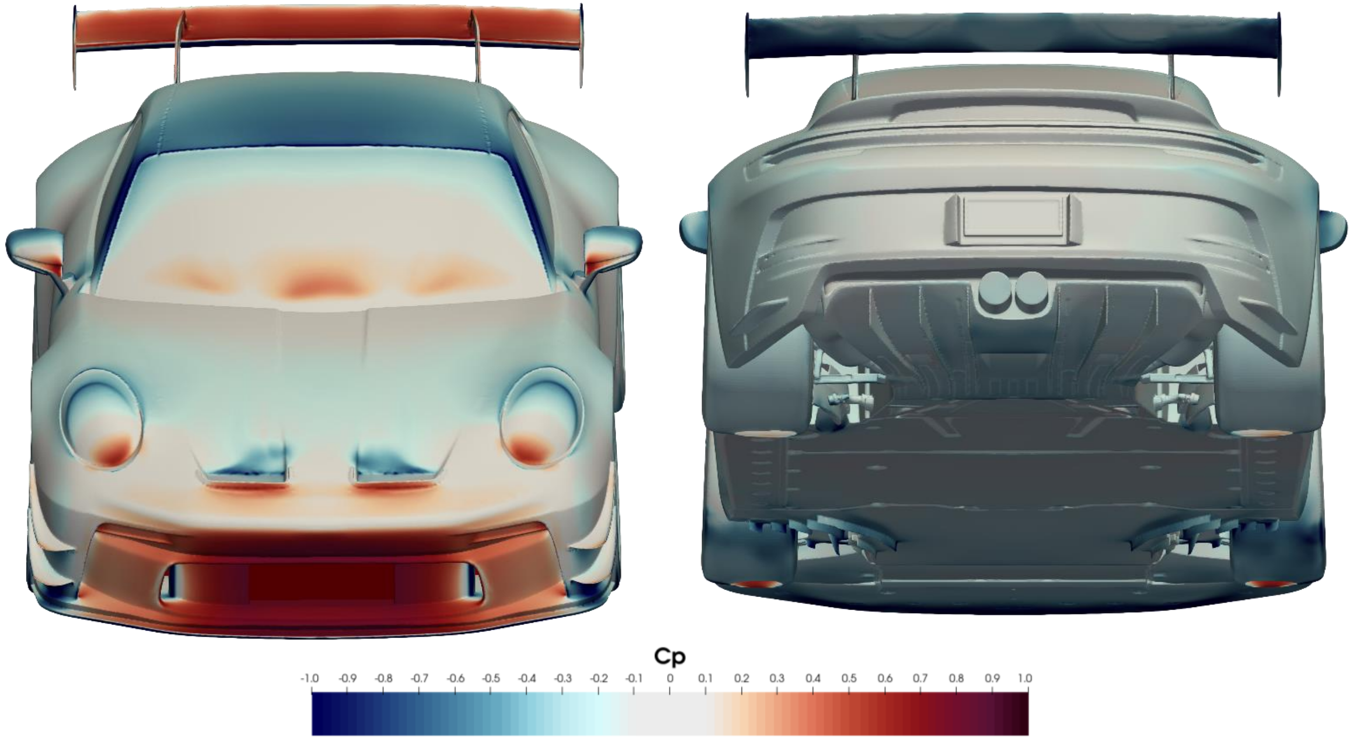
Dual Dive Planes:
The dive planes are manufactured with 2x2 twill carbon fiber and install with templates and double-sided tape.

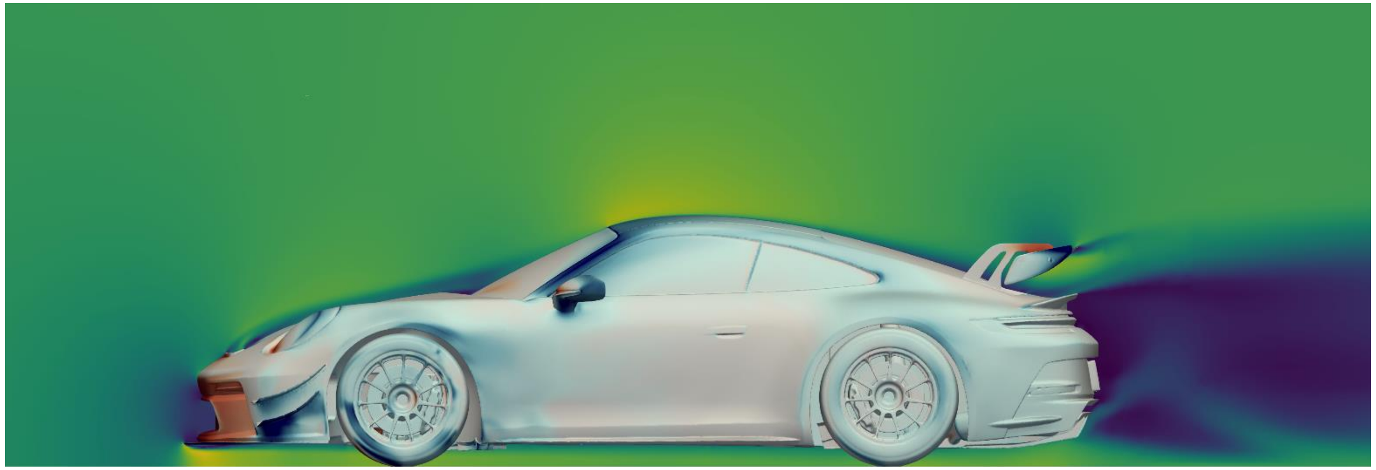
UPGRADED FACTORY WING MOUNTS

- New mounts for the factory Porsche Wing
- The new wing mounts allow the owner to adjust the factory wing to more angles of attack
- The factory wing was tested at increased angles of attack to verify increased performance.
- The mounts bolt on replacing the factory mounts utilizing all factory hardware.
- The mounts are machined in house out of 6061 Aluminum with a textured powdercoat finish.

REAR WING : UCW

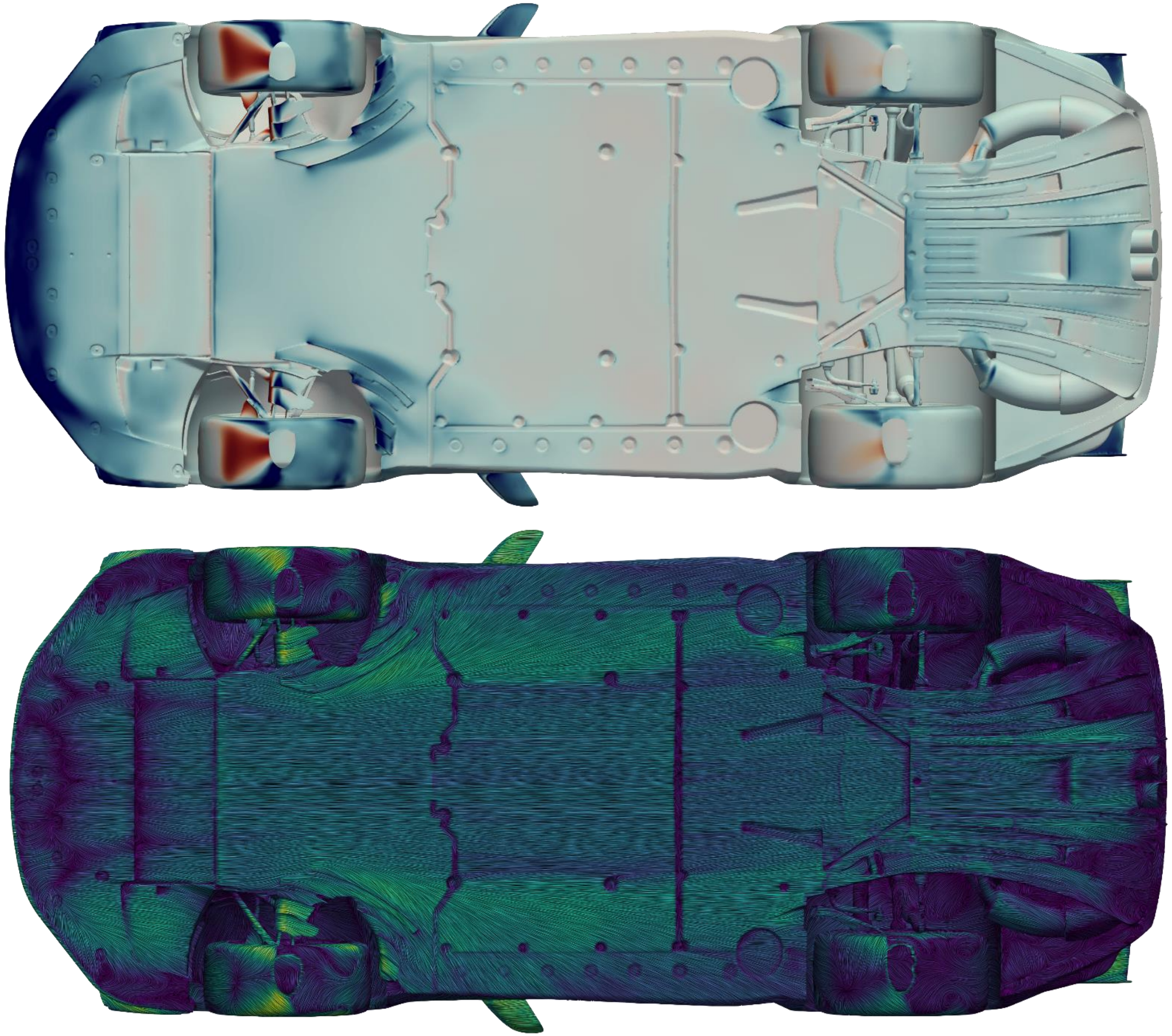
- The rear wing is great for customers looking for a large bump in rear downforce.
- The UCW wing profile was developed in CFD and refined in the wind tunnel.
- The airfoil produces efficient downforce on the 992 GT3.
- The bottom surface is where the majority of the downforce is generated. This low pressure pulls the car downward.
- The top surface still produces downforce, but not like the bottom surface.
- The Cp (coefficient of pressure) does not go above 0.7 on the top, but the bottom goes below -1. In other words, the bottom surface is working the wing harder. This is great as the 992 GT3 has a top mount from the factory.
- The wing bolts on like stock and is produced from 2x2 twill, pre-preg carbon fiber.





SPLITTER

- The splitter is great for customers looking to generate significantly more front end downforce.
- The entire splitter assembly is modeled and simulated.
- The splitter has an efficiency (L/D, Lift Over Drag) of 14.5. This is a very efficient aero device.
- High pressure on the top side helps drive the splitter downward at speed
- The bottom side, like the rear wing, produces more downforce than the top side.
- The bottom is designed to feed the factory splitter diffusers for improved performance.
- Our splitter is a motorsports grade composite material. Carbon polyweave is rigid while exhibiting excellent wear characteristics. Where traditional carbon fiber components may fail due to an impact, the carbon polyweave will not.



DIVE PLANES / CANARDS

- Dive planes are great for customers looking for a slight bump in front downforce and no reduction in ground clearance.
- Verus Engineering develops dive planes to produce downforce by controlling the flow around the vehicle, not on the units themselves, improving efficacy.
- A small amount of downforce is produced on the units themselves, high pressure on top, low pressure on bottom.
- We develop the dive planes to create a beneficial vortex which helps evacuate the fenders.
- This evacuation reduces lift on the body, improving performance.
- The dive planes are produced from 2x2 twill carbon fiber finished in an automotive clear coat. Templates are supplied to ensure location of the units are correct.

RADIATOR OUTLET GURNEY

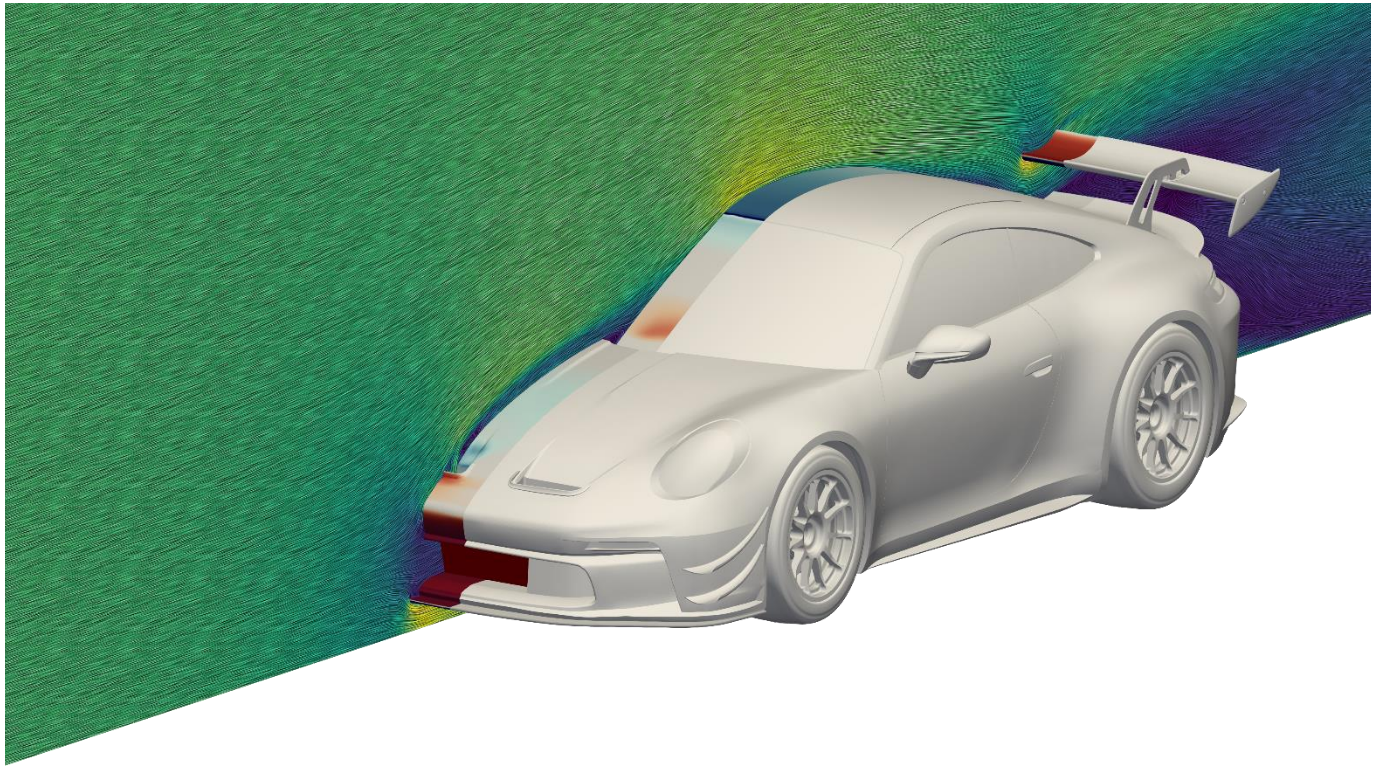
- Radiator Outlet Gurneys are great for customers looking for a slight bump in front downforce, shifting balance forward, and increase in flowrate through the radiator.

- The gurney increases high pressure in front of the gurney and decreases pressure behind.

- The gurney increases flowrate through the ducting which consecutively increases flowrate through the radiator.

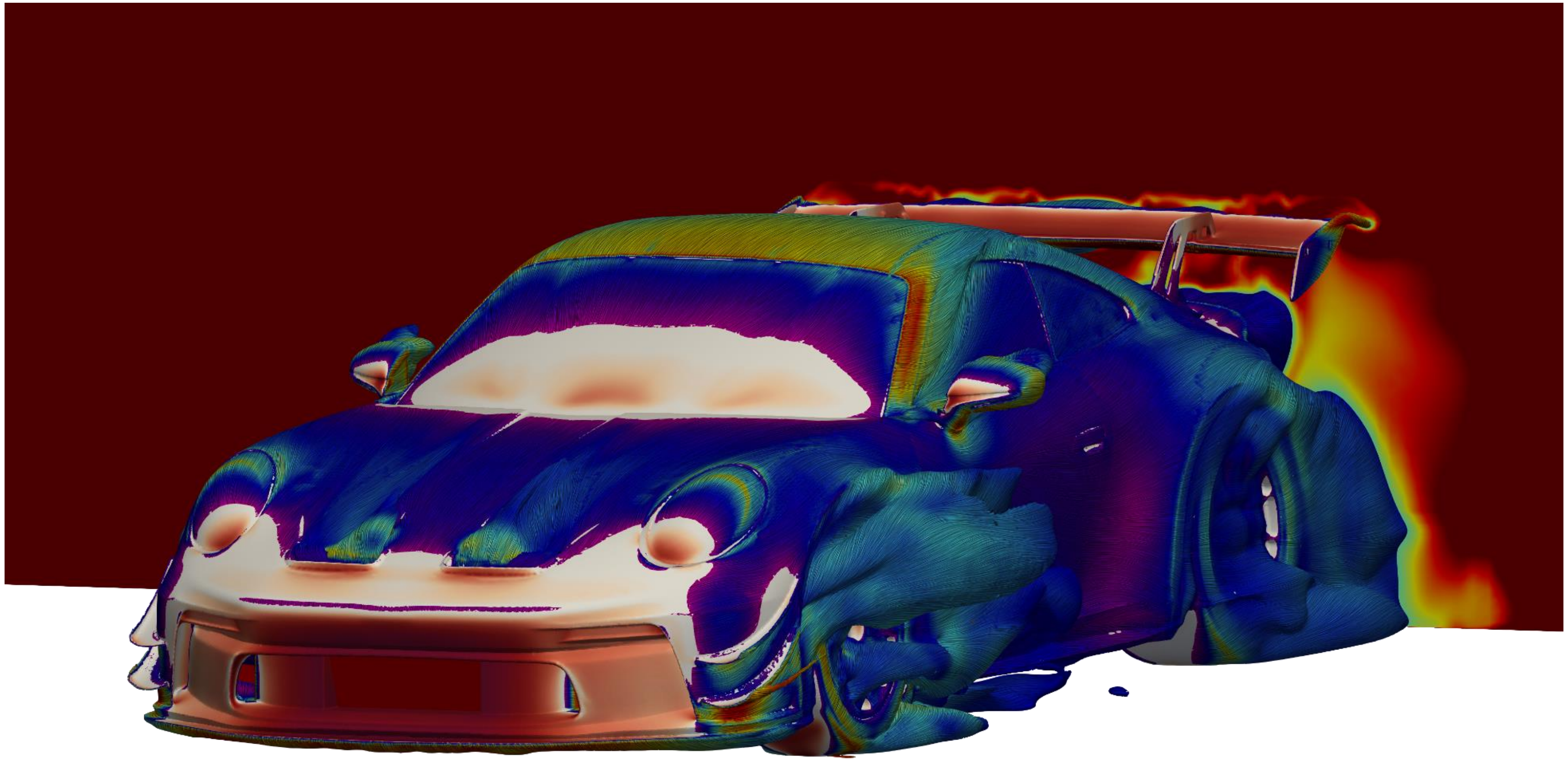
- The gurney increases high pressure in front of the gurney and decreases pressure behind.

- The gurneys are produced from 2x2 twill carbon fiber finished in an automotive clear coat. These line up with the body lines for correct fitment with double sided tape.



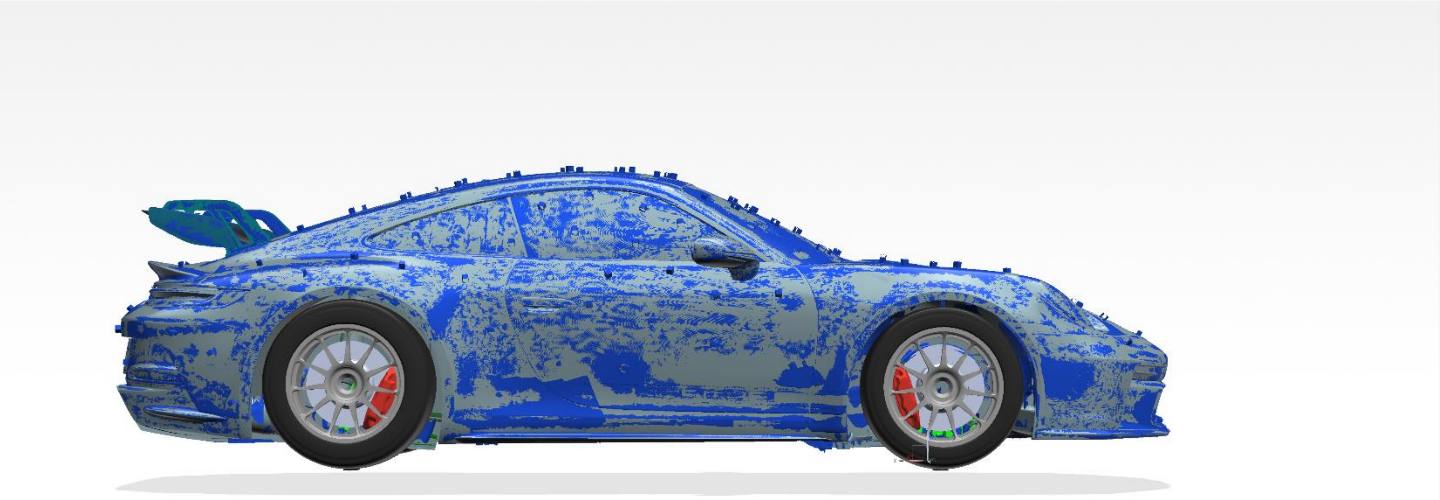
SUMMARY : GENERAL

- The Ventus kits are designed to decrease lap times utilizing well developed and functional aerodynamic components.
- The products feature an OEM like fit and finish with **zero permanent modifications** to the vehicles.
- The components increase vehicle performance.
- **No engine modifications means you retain the factory drivetrain warranty!**
- The R&D was done using cutting edge technology in CFD, wind tunnel testing, track testing with a professional driver, and proven designs from past work.
- Individual components can be installed without the full package, though to ensure a safe balance, we recommend the packages.



QUALITY OF CAD MODEL

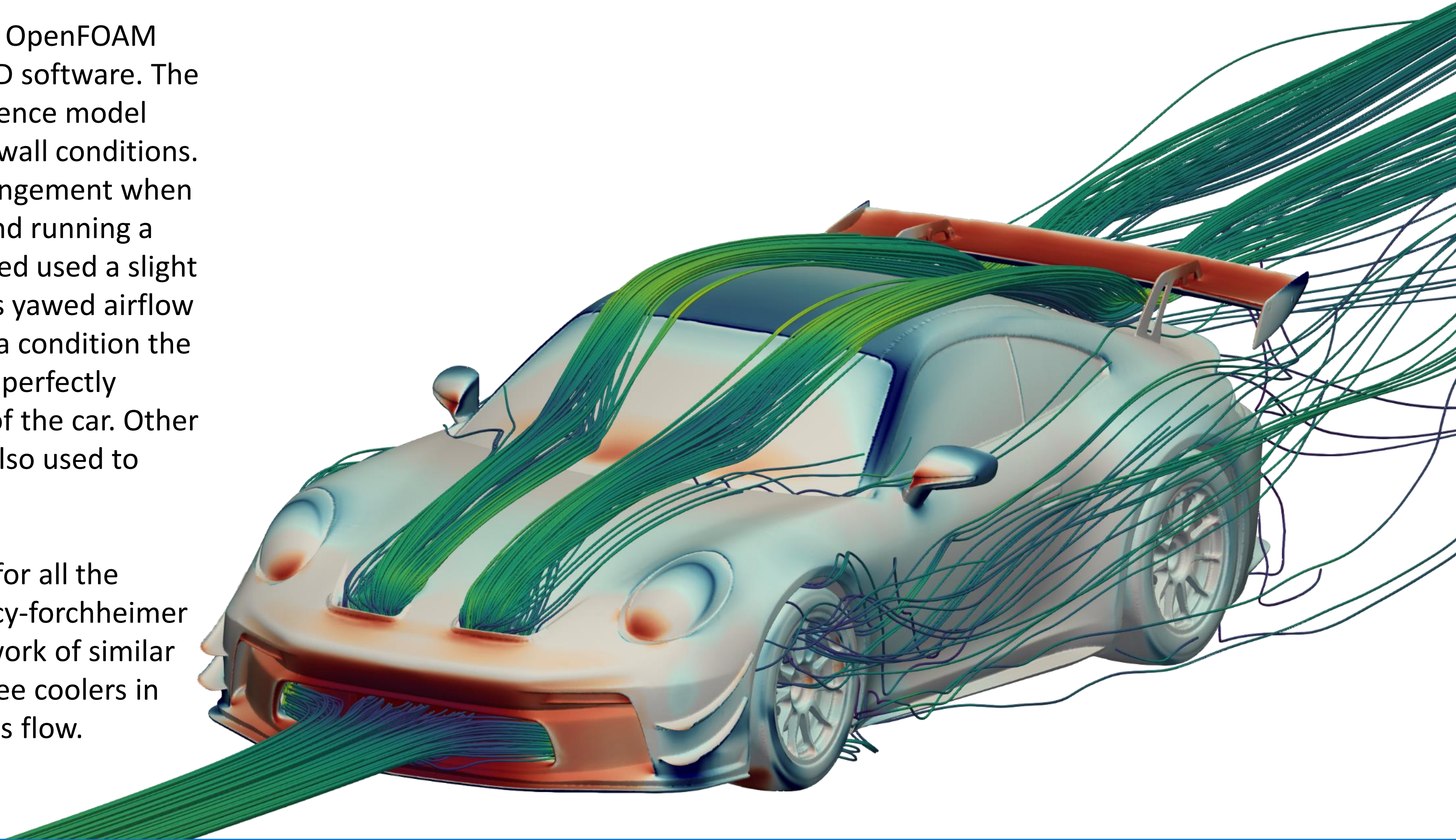
- The CAD model is a crucial aspect of accuracy.
- Bad inputs result in bad outputs.
- The CFD simulation is only as good as the geometry and setup of the CFD analysis.
- The 992 GT3 was scanned in house and a 3D CAD model was created from this scan.
- The image to the right shows the overlay of the CAD model (gray) and the scan (blue).
- The surfaces are less than 1mm off from the actual scan model in the "worst" locations, with most of the car being less than this.
- Through ducts and radiator ducting were modeled for improved analysis accuracy.



THE SCIENCE

The development was done using OpenFOAM v2106 which is a finite volume CFD software. The solver was SIMPLE and the turbulence model was K-Omega SST using standard wall conditions. We use standard automotive arrangement when setting up boundary conditions and running a full-car. Most of the cases simulated used a slight yawed airflow of 0.5 degrees. This yawed airflow is to ensure we are not analyzing a condition the car will almost never see which is perfectly straight airflow down the length of the car. Other ride heights and yaw rates were also used to simulate cornering.

The use of porous flow was used for all the cooling stacks on the car. The darcy-forchheimer values used were based on past work of similar radiators/heat exchangers. All three coolers in the front were used for the porous flow.



DEFINITIONS

1. **Coefficient of Pressure (Cp)** = This is a dimensionless number which describes relative pressure to atmospheric pressure. A Cp of 0 equates to atmospheric pressure while a number below 0 represents low pressure and a number above 0 represents high pressure.
2. **CpX** = This is a dimensionless number which describes Cp normal to the x-direction. This helps us visualize locations which create drag. Red represents locations which are creating drag, while blue represents locations where thrust is created.
3. **CpZ** = This is a dimensionless number which describes Cp normal to the z-direction. This helps us visualize location which create downforce or lift. Red represents locations which are creating lift, while blue represents locations where downforce is created.
4. **Total Pressure Coefficient (CpT)** = This is a dimensionless number which describes total energy of the airstream. It is the sum of static pressure and dynamic pressure.
5. **Wall Shear** = This is a force per unit area due to fluid friction on the wall. This is used to visualize areas of separation and rapid changes on the surface.
6. **LIC Plot** = Line integral convolution (LIC) is used to visualize “oil” flow on the surface. It is a great way to correlate to flow vis testing and to study the flow on the surface of the vehicle.
7. **Streamline** = These are fluid tracers which are used to visualize where the air is going or coming from. These are normally colored as velocity where red is high-velocity and blue is low-velocity.
8. **Points** = One point is considered 0.001 of a coefficient. This is used in coefficient of drag (Cd) and coefficient of lift (Cl).