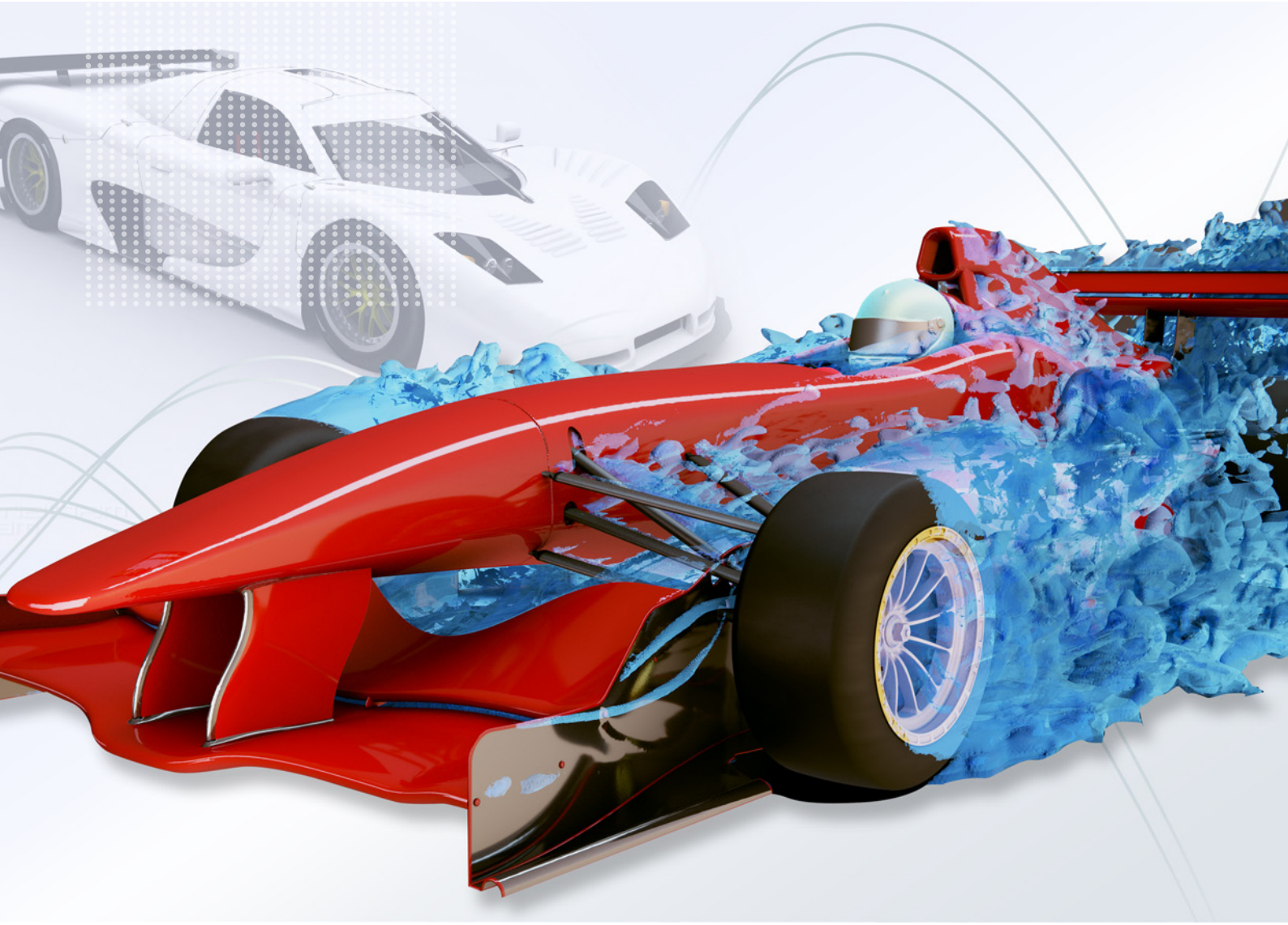
TOTALSIM

EXPERTS IN
COMPUTATIONAL FLUID DYNAMICS



TS AUTOMOTIVE AND MOTORSPORT

WWW.TOTALSIMULATION.CO.UK

TOTALSIM

TotalSim is an independent CFD consultancy firm specialising in aerodynamics and fluid flow analysis through the use of open source computational methods.

TotalSim was established in 2007 by the current managing director Dr Rob Lewis. TotalSim was a natural replacement for the successful Advantage CFD (established in 1998) which was part of the Honda Formula 1 team until 2006.

TotalSim is based in Brackley, Northamptonshire. We currently employ 20 people in the UK and the company is largely employee owned. We have a sibling office in the USA, sharing our business model and intellectual property.

TotalSim has over 100 years of combined CFD experience in the automotive and motorsport industry. We are experts in the use of CFD.

TotalSim has designed and developed race cars in nearly all forms of motorsport, ranging from Formula 1 cars to Le Mans Prototypes, GT sportscars and many more.

TotalSim also has extensive experience in road car development helping several large OEMs with product development and support.

TotalSim are world leaders in the use of the open source CFD solver OpenFOAM®* for automotive and motorsport applications. We work closely with the lead developers of OpenFOAM® to generate new codes and improve existing methods.

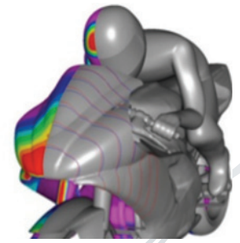
TotalSim can also provide support for those wishing to run their own CFD programmes. We offer support packages sharing all of TotalSim's methodologies and codes focused around OpenFOAM®.

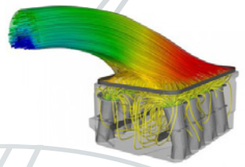
TotalSim has developed its own custom built high performance computing system, giving access to over 1400 CPU cores, in the UK office alone. TotalSim can supply hardware based around our own bespoke low cost recipe, purposely built for CFD.

IN SUMMARY, TOTALSIM CAN PROVIDE COST-EFFECTIVE CFD CONSULTANCY, SUPPORT, METHODOLOGY, TRAINING AND HARDWARE, ALL WITHIN A RIGID TIMEFRAME.

**OPENFOAM® is a registered trademark of OpenCFD Limited, the producer of the OpenFOAM software. This offering is not approved or endorsed by OpenCFD Limited, the producer of the OpenFOAM software and owner of the OPENFOAM® and OpenCFD® trademarks.*

COMPUTATIONAL FLUID DYNAMICS (CFD)





TotalSim's CFD capabilities and experience is amongst the best in the world.

TotalSim can model just about all fluid problems, providing analysis and understanding to complex real world problems.

The number of different applications of CFD within the automotive industry is just about endless but, below is a list of some of areas TotalSim can help with:

- **External aerodynamics**
- **Internal flows** – Modelling of flows inside engine bays and cabins
- **Cooling flows** – Maximising cooling flow to radiators and brakes
- **Exhaust flows** – Modelling of flow from the engine exhaust gases
- **Thermal modelling** – Modelling of heat rejection from brakes, engines and exhausts
- **Engine intake development** – Maximising the efficiency of engine intakes and airboxes
- **HVAC flows**
- **Compressible flows**
- **Multiphase flows including fuel fill**
- **Noise modelling**

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AERODYNAMIC DEVELOPMENT

TotalSim are experts in the aerodynamic design and development of automotive and motorsport vehicles. We have led numerous development programmes working on conceptual designs and prototypes through to full production road and race cars.

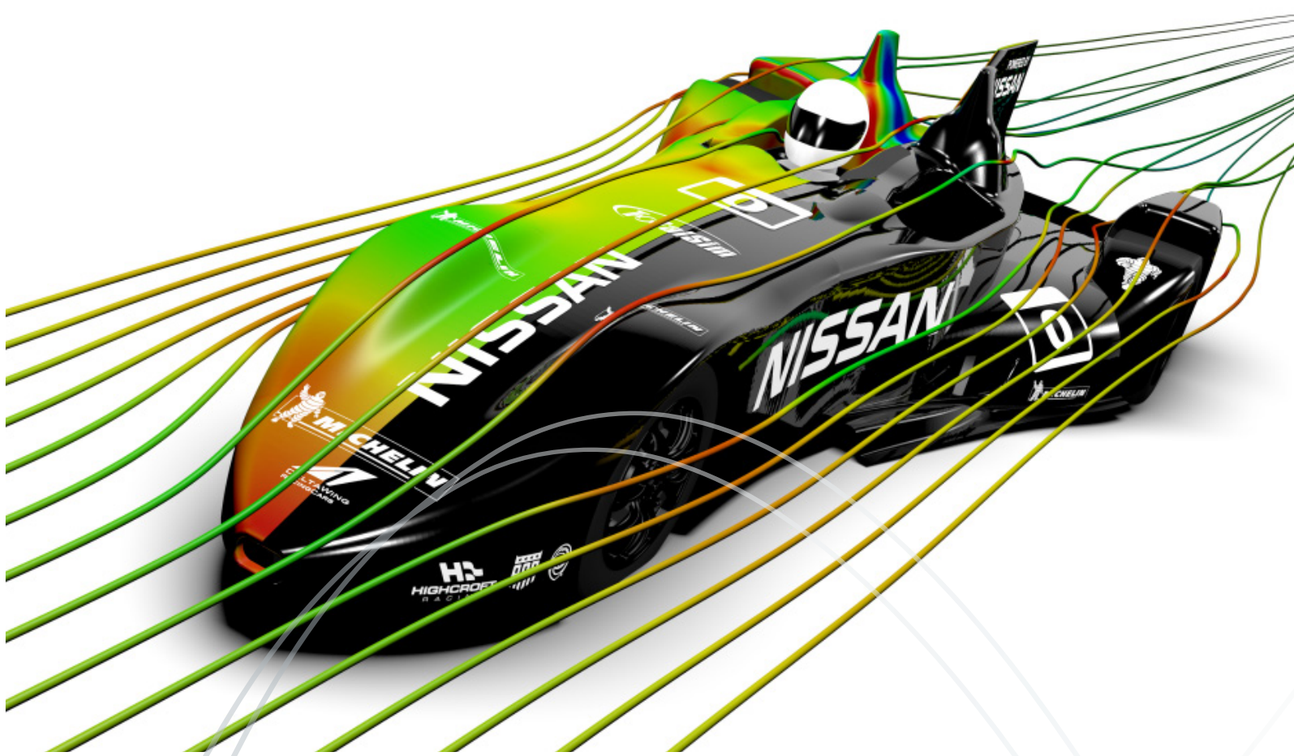
TotalSim can provide complete aerodynamic analysis of external and internal flows. We can quickly evaluate key aerodynamic data such as drag, downforce, balance and cooling flows.

TotalSim has developed a highly efficient and refined CFD process that allows for rapid turnaround of results.

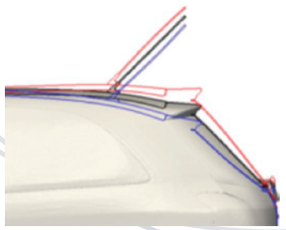
TotalSim has the resources to conduct a large number of CFD simulations concurrently, allowing for rapid aerodynamic development.

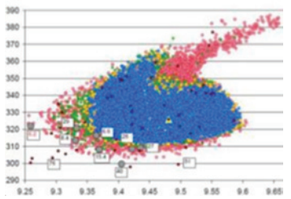
TotalSim can optimise individual components using advanced multi-parameter optimisation techniques coupled with CFD morphing technology.

TotalSim has consistently delivered performance gains seen computationally to the track. Several of our clients now go directly from CFD to track testing, removing the need for expensive wind tunnel testing.



OPTIMISATION





TotalSim are at the forefront of multi-parameter optimisation techniques and CFD morphing technology. We are capable of running hundreds of design iterations within a given design space both quickly and efficiently.

TotalSim's unique optimisation process uses a combination of sophisticated mesh deformation tools and advanced kriging routines. Our process has been developed and refined over many years to create a robust and proven development tool.

Key to our optimisation process is Sculptor® (www.gosculptor.com), a powerful yet flexible mesh deformation tool. Sculptor® can rapidly morph a processed CAD model into an infinite number of variations, reducing the need for complex and time consuming CAD updates and saving significant time and money. TotalSim are resellers of Sculptor® in the UK.

Our optimisation process allows multiple geometric parameters to be optimised against multiple performance functions. This may be as simple as a wing angle optimisation or as complex as simultaneous changes in camber, twist, thickness and chord length of a multi-element wing. Optimisations can be performed at multiple attitudes and flow conditions and traded off against each other, to maximise car performance in different situations.

TOTALSIM'S OPTIMISATION PROCESS WILL MAXIMISE PRODUCT PERFORMANCE, USING AN EFFICIENT AND COST-EFFECTIVE SOLUTION IN THE QUICKEST TIME POSSIBLE.

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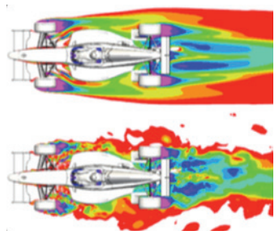
PERFORMANCE MAPPING

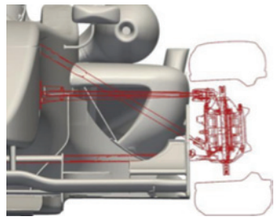
TotalSim has the ability to map the aerodynamic performance of vehicles over a range of:

- Ride heights (including roll, pitch, steer and yaw)
- Speeds
- Wing angles
- Gurney heights



TotalSim's bespoke performance mapping tools are quick to setup, fully automated and allow for rapid turnaround of CFD results.

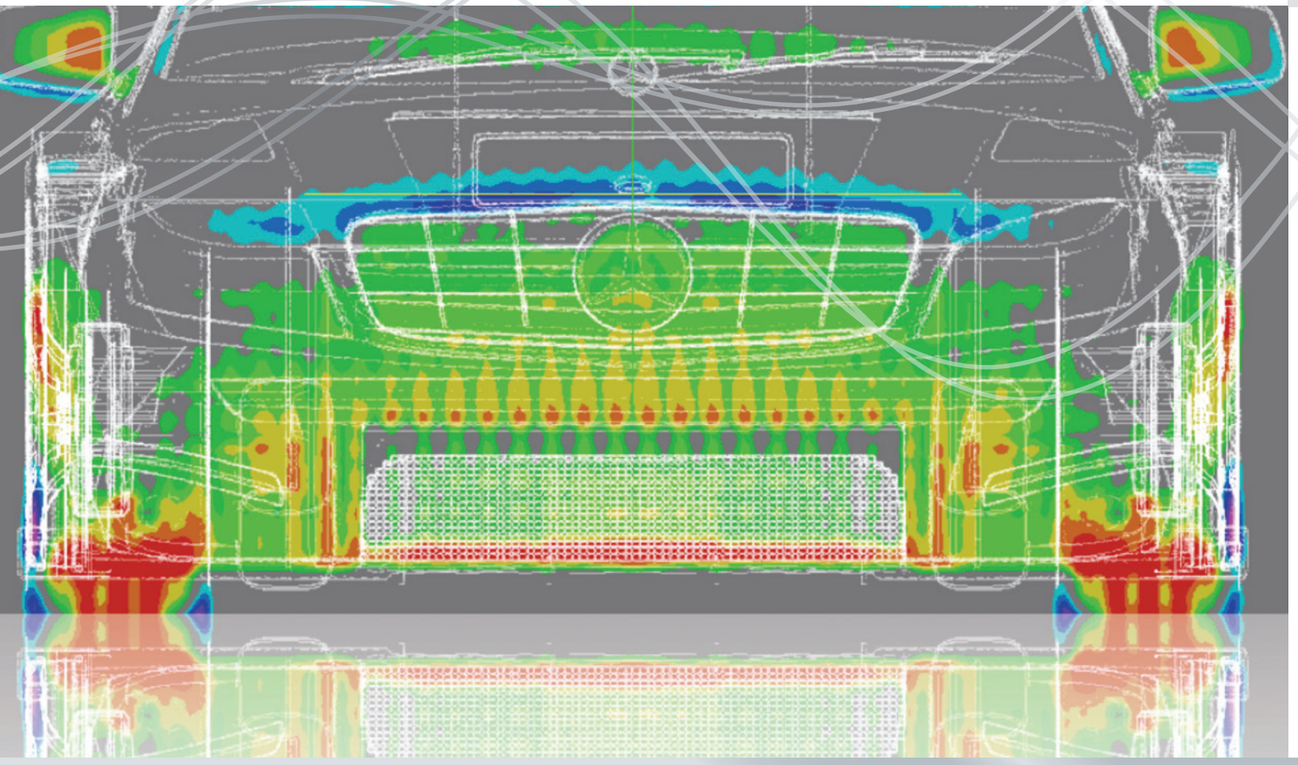
Performance mapping tools are designed to manipulate the pre-processed CFD model without the need for complicated and time consuming CAD model updates.



In particular, TotalSim has developed a sophisticated 'Ride Height Changer' tool which can automatically update the geometry of the CFD model based on a given ride height setting.

'Ride Height Changer' applies kinematic translations and rotations on suspension and wheel components to accurately represent the orientation of the real life vehicle undergoing roll, pitch or yaw.

'Ride Height Changer' is highly flexible, allowing the user to specify front and rear ride heights, roll, yaw and steer. This can all be automated for a number of flow conditions.



SUPPORT CONTRACTS

Training, Methodology, Software and Software Development.

Our support contracts can be tailored to your needs. Whether you are a large organisation or single user we have a support contract that can help you.

TotalSim provide a whole suite of tools and a **tested methodology** based around **open source codes** that we use within our own consultancy business.

TOTALSIM PROVIDE MORE THAN JUST CFD SOFTWARE.
WE WILL MAKE CFD WORK FOR YOU.

Support contracts start from as little as **£8500 with no annual licencing fees.** This includes our software/codes, support time and a contribution to a central development fund (to help continue the development of our codes).

Your support time can be used for development, training (on or offsite) and auditing.

TotalSim can help develop your own in-house CFD capability, providing training and CFD support, software and hardware. We can even advise on recruitment, and provide extra personnel during those busy times.

CUSTOM CFD HARDWARE

CFD Hardware by CFD users, for CFD users.

TotalSim have developed a custom CFD hardware solution through their consultancy business and are offering that solution to other CFD users.

TotalSim are constantly revising their CFD recipe to ensure that the solution is:
COST EFFECTIVE, ENERGY EFFICIENT AND FAST.

The latest generation is no exception.
The latest recipe is rack mounted, which means it is easily scalable from 6 to 192 nodes or more.

LIKE EVERYTHING AT TOTALSIM OUR
HARDWARE PHILOSOPHY IS OPEN.

We will create you a cluster to meet your needs.
We will use our knowledge of CFD and CFD hardware to make sure you only pay for what you need and nothing more.

Our pricing strategy is unique. We charge for the components with a handling fee of 5% and assembly time at £95/hour. All of our IP that has gone into designing and testing the cluster is completely free.

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REFERENCES

TOTALSIM ARE VASTLY EXPERIENCED WHEN IT COMES TO AUTOMOTIVE AND MOTORSPORT CFD.

We have worked in nearly all motorsport series worldwide, ranging from Nascar to F1.

In the Motorsport world we have worked with 8 different F1 teams.

In the Automotive world we have worked with 6 OEMs worldwide.

WHAT OUR CLIENTS SAY ABOUT US

Willem Toet
Head of Aerodynamics at the Sauber F1 Team

"I was looking for a cost effective solution with fast turnaround times, so I turned to TotalSim. I'm really glad I did!"

Ben Bowlby
Motor Racing Designer and DeltaWing Concept Originator

"The DeltaWing Le Mans 2012 project would have been impossible without the advances in computational modeling of many vehicle performance parameters. Most significantly for this project was the Computational Fluid Dynamics modeling provided by TotalSim; the revolutionary aerodynamic package that lead to the doubling of the car's fuel efficiency compared to contemporary Le Mans cars was developed entirely using the services provided by TotalSim. The speed of turnaround, accuracy of data, advanced analysis techniques and excellent reporting methods were vital to the success of the project."

Chris Boardman
Head of Research and Development British Cycling

"TotalSim consistently provided innovative ideas."

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