

# Aerodynamic testing in Circuit Motorsport

Evan Arthur

Andrew Noble

Wales Institute for Science & Art

BEng Foundation Motorsport Engineering

### Introduction

A large motivation behind this project is the development of the UWTSD Sports2000 MCR Race cars over the years and how different measures were used to gather the data that excelled this forward.

The expansive area of aerodynamic testing in higher budget motorsports, such as F1, provides a good insight as to the scale of testing that takes place and the level of technology that is available in the modern day through physical, computational and artificial intelligence testing.

### Wind Tunnels

Wind tunnels in motorsport play a large role as it is an excellent way of identifying and comparing performance between iterations of vehicle. The controlled environment of a wind tunnel will allow the user to gather data points such as drag, downforce coefficient, lift coefficient and balance at a high degree of accuracy. This is because there are no crosswinds or track impurities to be considered and the windspeed is a controlled value.

An example of this is shown in figures 1&2.

**CFD (Computational Fluid Dynamics)**

CFD is used in motorsport to simulate how the car can/will respond to certain dependencies such as track temperature, variable wind speeds and track impurities. This is used in Formula 1 to simulate the performance of the car/components by evaluating the airflow contextual to the car. From this data, the team can make necessary changes and optimise the design before on-track testing. This saves resources and time while also allowing for more and faster iterations of car and components.

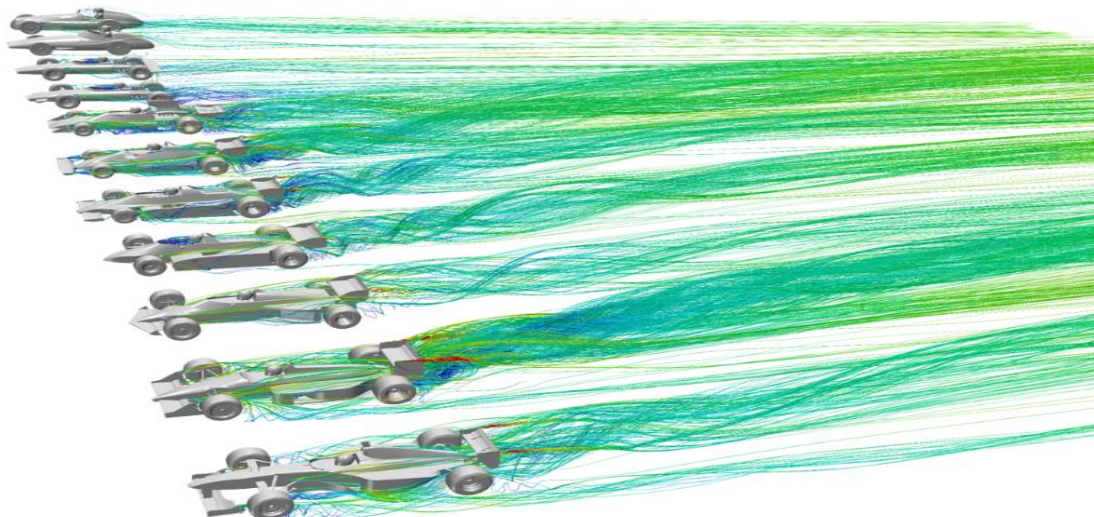
Elsewhere, CFD is used similarly with the sole purpose being to reduce overall costs, cut down time and decrease margin of error during the testing phase. (Vardhan, 2023)



Figure 1

UWTSD later took the car back to MIRA with the updated bodywork and ran tests. This allowed the team to analyse the changes made and how they affect the overall performance and aerodynamic efficiency of the car.

- Image taken from the UWTSD Motorsport Instagram page.  
[https://www.instagram.com/uwtsd\\_motorsport/](https://www.instagram.com/uwtsd_motorsport/)



This image shows the progression of aerodynamics over the years in F1 and how it has changed with use of CFD. (Beves, 2018)

### Aero Paint

Aero paint is a vibrant, often paraffin oil based, solution which is applied to the vehicle before a track or wind tunnel test. The paraffin (and dye) is light and easily moveable by the air, so the paraffin evaporating allows the paint to dry leaving a clear visual of the airflow over the car.

This is used by aerodynamicists to get a better view of how the air is interacting with the car which is analysed for things such as flow separation. (Smedley, 2019)

UWTSD testing their MCR race car at MIRA wind tunnel.

“We did this (wind tunnel testing) with the old bodywork to allow us to have data to work with when testing the new bodywork.” – Tim Tudor.

This gave the team a good insight as to what can be improved and where.

- Image taken from the UWTSD Motorsport Facebook page.  
<https://www.facebook.com/UWTSDMotorsport>



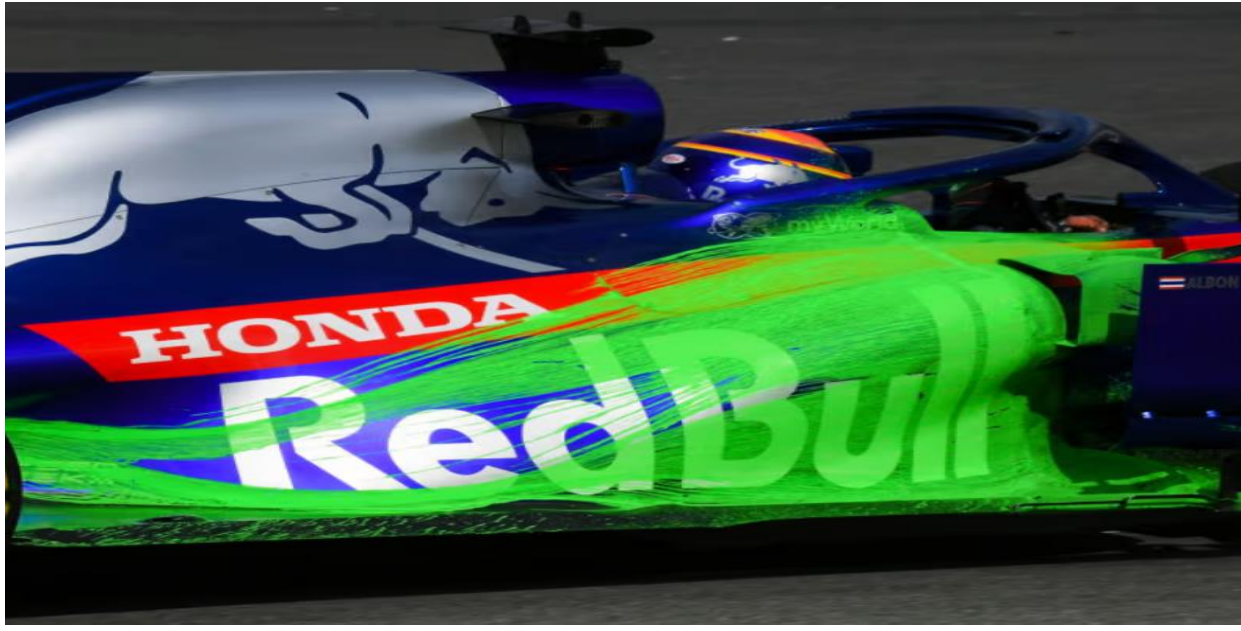
Figure 2

Using this data from the various tests ran by UWTSD, the old bodywork was changed and improved massively, giving an increase in downforce larger than 200% while producing approximately the same drag. However, the car was around 40% front balanced, meaning the car tended to oversteer often.

| @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%)           |

This bodywork was then polished and refined further to create larger amounts of downforce. The bodywork now produces 422% more downforce than the ‘baseline’ bodywork they started with.

|              | 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%)          |



Aero Paint (Flo-vis) on Albon’s 2019 Toro Rosso (Smedley, 2019)

### References

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