Uncovering Design Engineering Secrets for Success

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Motorsport's place in the wider engineering world

- Racing can be a proving ground for future engineering technology
- Motorsport needs to anticipate and implement expected trends
- Other engineering sectors can provide motorsport with expertise

The cusp of a changing automotive sector

COP26's Paris Agreement - a pledge from 34 national governments, multiple automakers and cities to phase out sales internal combustion engine-powered vehicles, and promote sales of Zero Emissions Vehicles (ZEVs) by 2040 (2035 in 'leading markets')

F1 hybrid technology since 2014, expected 2026 shift to fully sustainable fuels

Formula E promoting electric vehicles, contested by multiple manufacturers

Hydrogen still under consideration as fuel for alternative propulsion vehicles

Designing for speed

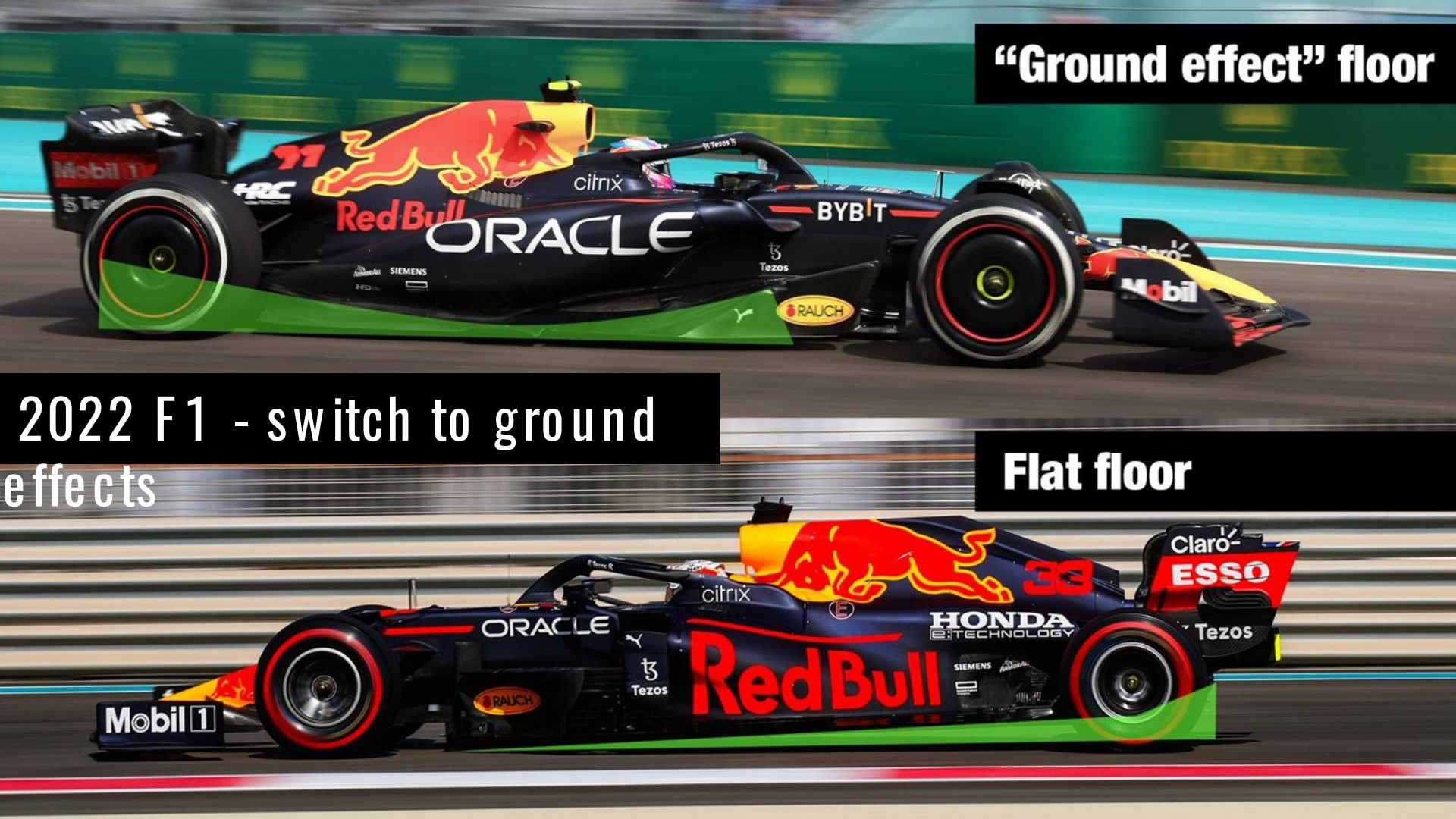
How do you design to win in motorsport?

Good question - nobody knows!

Racing teams are full of some of the brightest scientific minds all trying to make a car go faster.

It starts with an initial concept, and continues through development.

All-new F1 rules applied for 2022 season, and nobody knew how to design the best car!


“Ground effect” floor
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SIEMENS
RAUCH
Mobil 1


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ROLEX
2021 Mercedes W12


2022 Mercedes W13

The ingredients for success in racing

Employ a wide variety of knowledgeable and creative engineers

McLaren MP4-13

Winner of 1998 F1 constructors' championship

Took Mika Hakkinen to drivers' title

Competition

Regulations are the brief - but require lateral thinking

Rules are meant to be bent, not broken

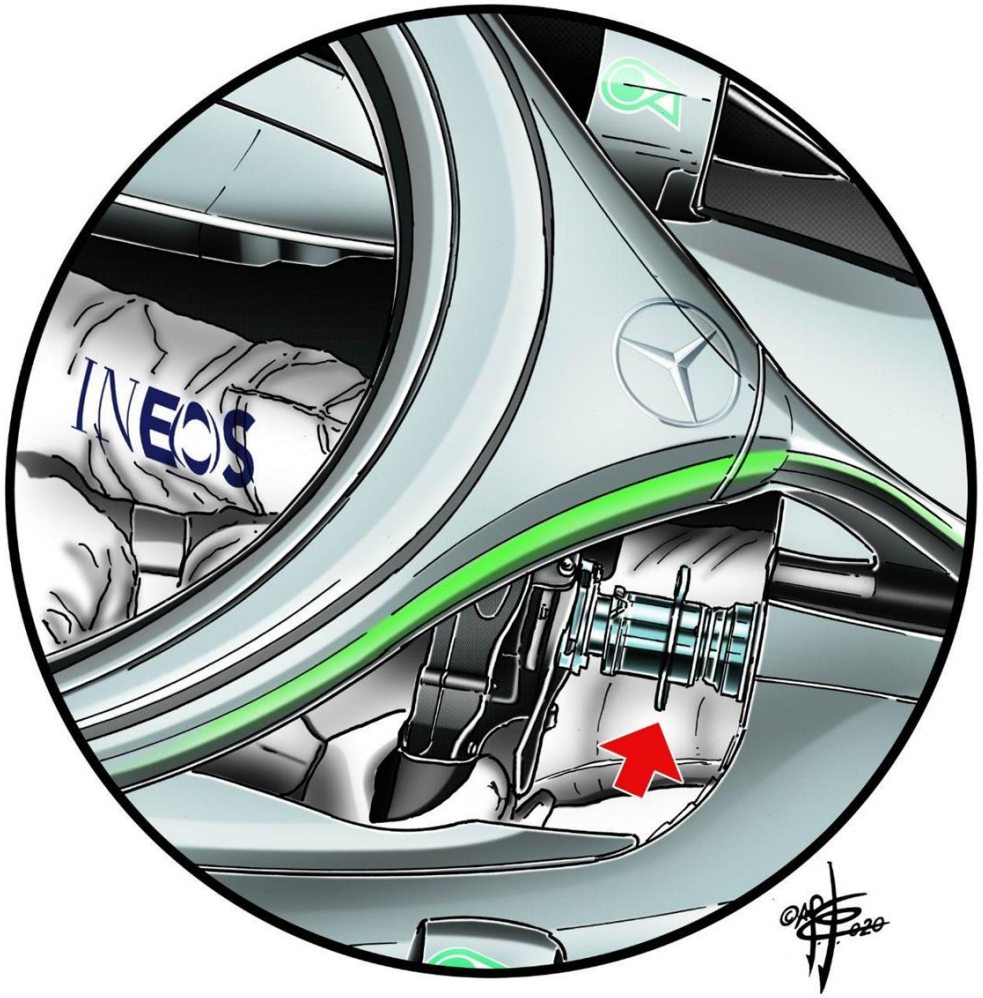
The ingredients for success in racing

A wide variety of knowledgeable and creative engineers

Know your strengths and your weaknesses

Mercedes W11 DAS

Directional change of wheels has to be operated by steering system



The ingredients for success in racing

A wide variety of knowledgeable and creative engineers

Know your strengths and your weaknesses

Develop your car - but know when to stop


Making sense of the data

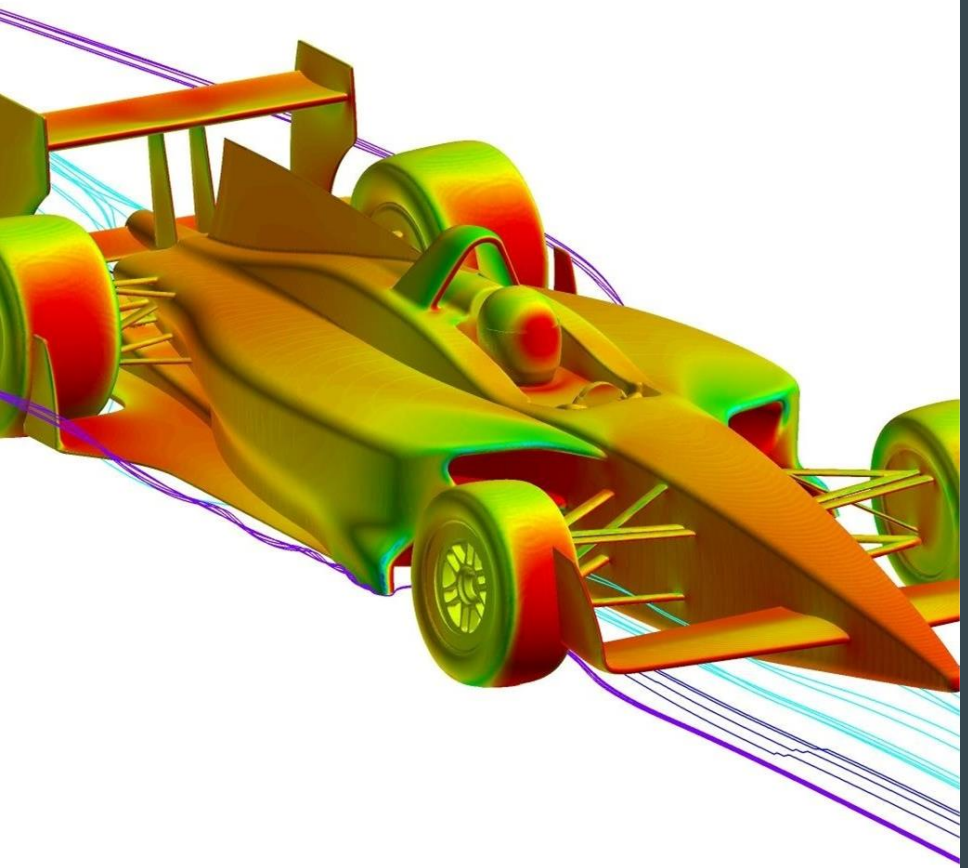
Computational approaches

Simulations considerably more widespread in motorsport

Teams employ multiple data engineers for the circuit, and simulation engineers at base

Heavy reliance on mathematical modelling of physics, tyres, etc.

Correlating data from virtual world to reality



Data for design

Computational Fluid Dynamics (CFD) has become prevalent in past 25 years

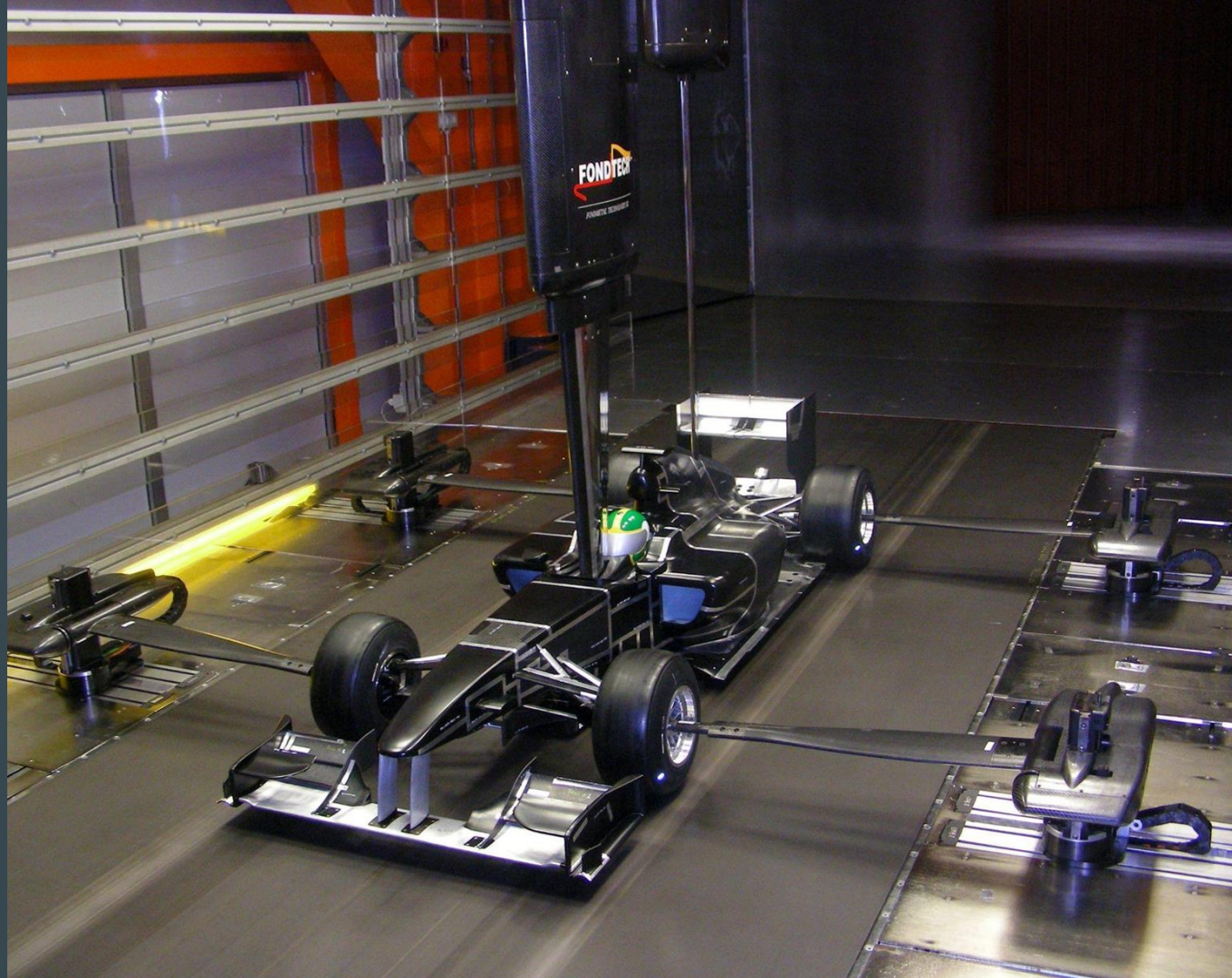
Applies physical principles to virtual car model

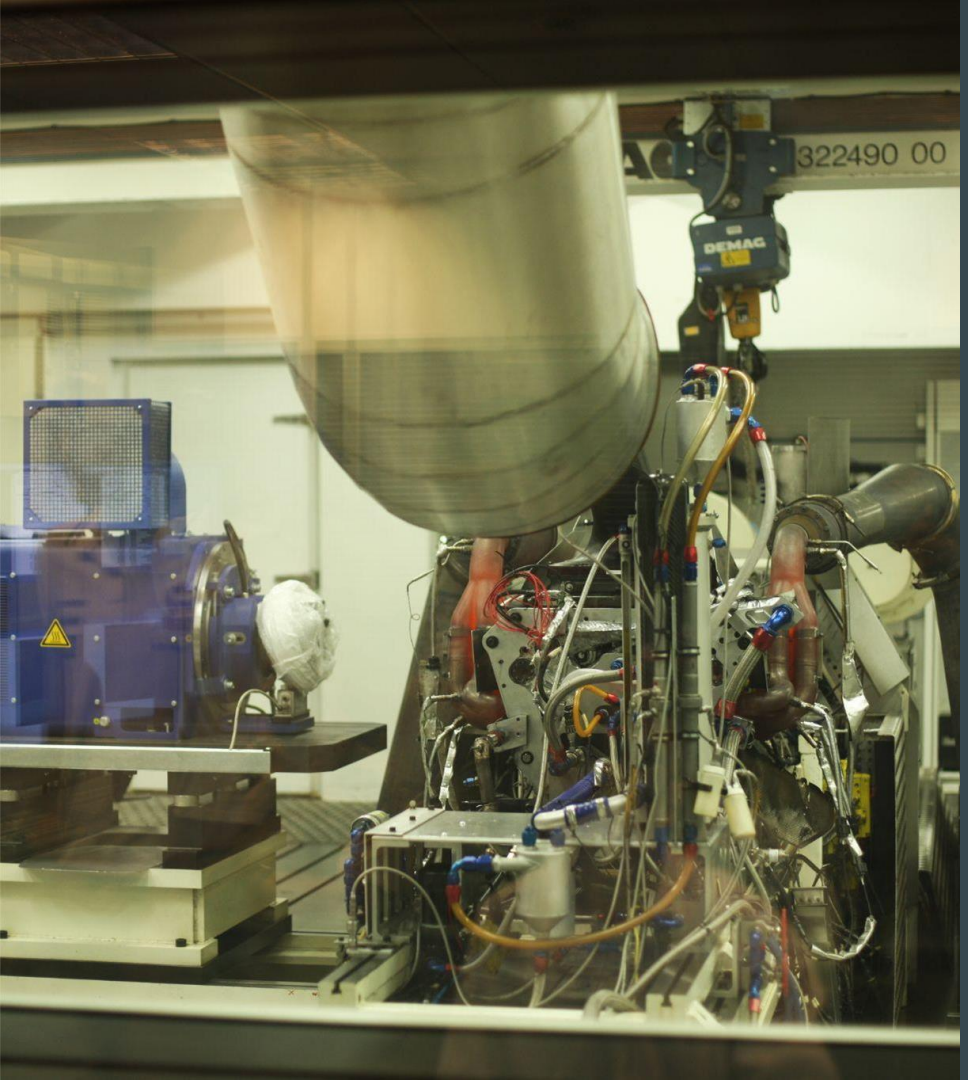
Data for design

Windtunnels generally used to validate CFD results, using real-world physics

Can be installed with rolling roads to simulate motion

Use of pressure tapping to determine results





Data for design

Engine dynamometers (dynos) used to run engines through various modes and speeds

Can be used for power testing or for reliability testing

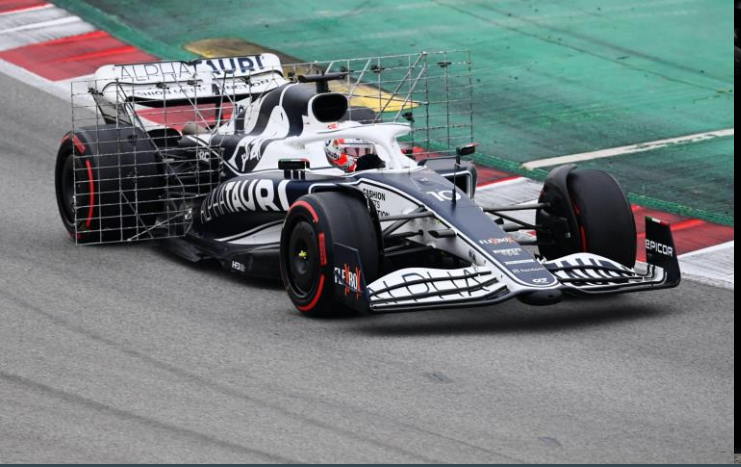
Shaker rigs used to test car handling responses, kinematics

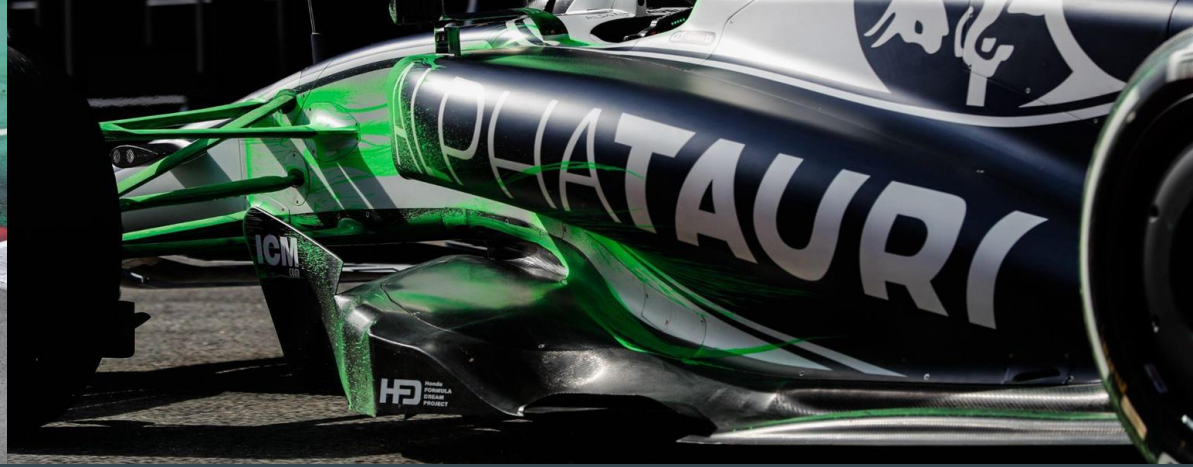
Correlation with aero testing tools

Teams have limited testing in modern F1

“Aero rakes” have pressure tappings to correlate between virtual tests and real world effect

“Flow-vis” paint helps determine direction of airflow and attachment





Correlation

Important to ensure simulation methods are accurate

Sometimes, what works in CFD/windtunnel doesn't translate to reality

CFD becoming more accurate - but not a substitute for real-world experience

CFD Analysis of pressure coefficient

Taking pressure slices in CFD, can visualise flows - in this instance, a Force India VJM01 front wing

Can be correlated with windtunnel and on-track data to improve simulation accuracy

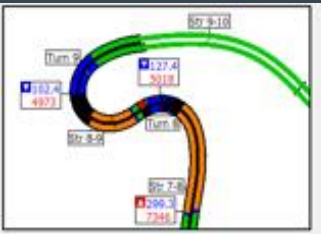
Data for setup

Racing vehicles have multiple sensors feeding into a data logger

Engineers trackside have live data feed to check car, driver inputs and GPS

Changes can be made to cars (or bikes) via pit-wall or in driver communication

Data analysis example - comparison of tyre saturation



How do you build for success in racing?

Race teams and design teams must work in harmony.

Design teams must have clear leadership - but room to be creative.

Car must either have wide set-up window - or an easily exploitable one.

Find the best drivers you can afford - or can attract to the team.

Ensure developments are well-tested - and add value to car.

Money, and lots of it!


Any questions?
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