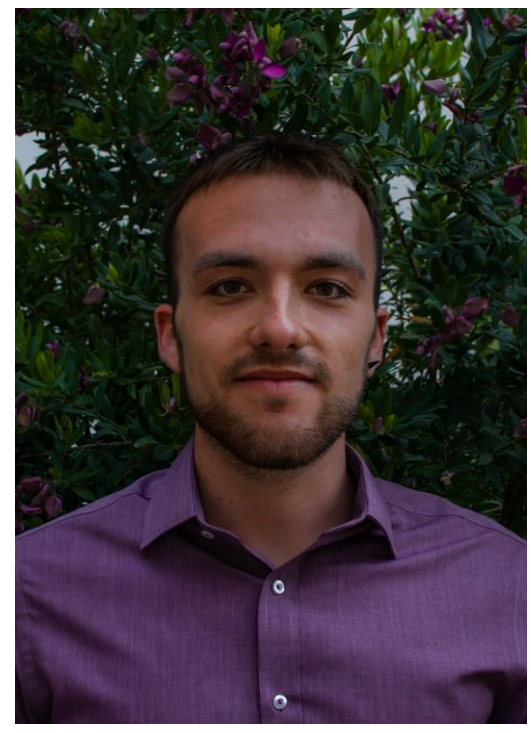




Parametric Diffuser Development for the MCR S2000 with the use of CFD

Christos David Zois

Tim Tudor

School of Engineering

BEng Motorsport Engineering



Project Aims

A number of studies were conducted using CFD to develop a diffuser specification for the MCR S2000 car to compete within the OSS Championship. The aims of the project were to increase aerodynamic performance and to bring the CoP further rearwards due to a new splitter design producing large amounts of frontal downforce. Initially the centre section of the diffuser was developed followed by the side tunnels. Finally, a study with the goal to reduce tyre squirt was conducted. Attitude studies were performed for the initial and final designs.

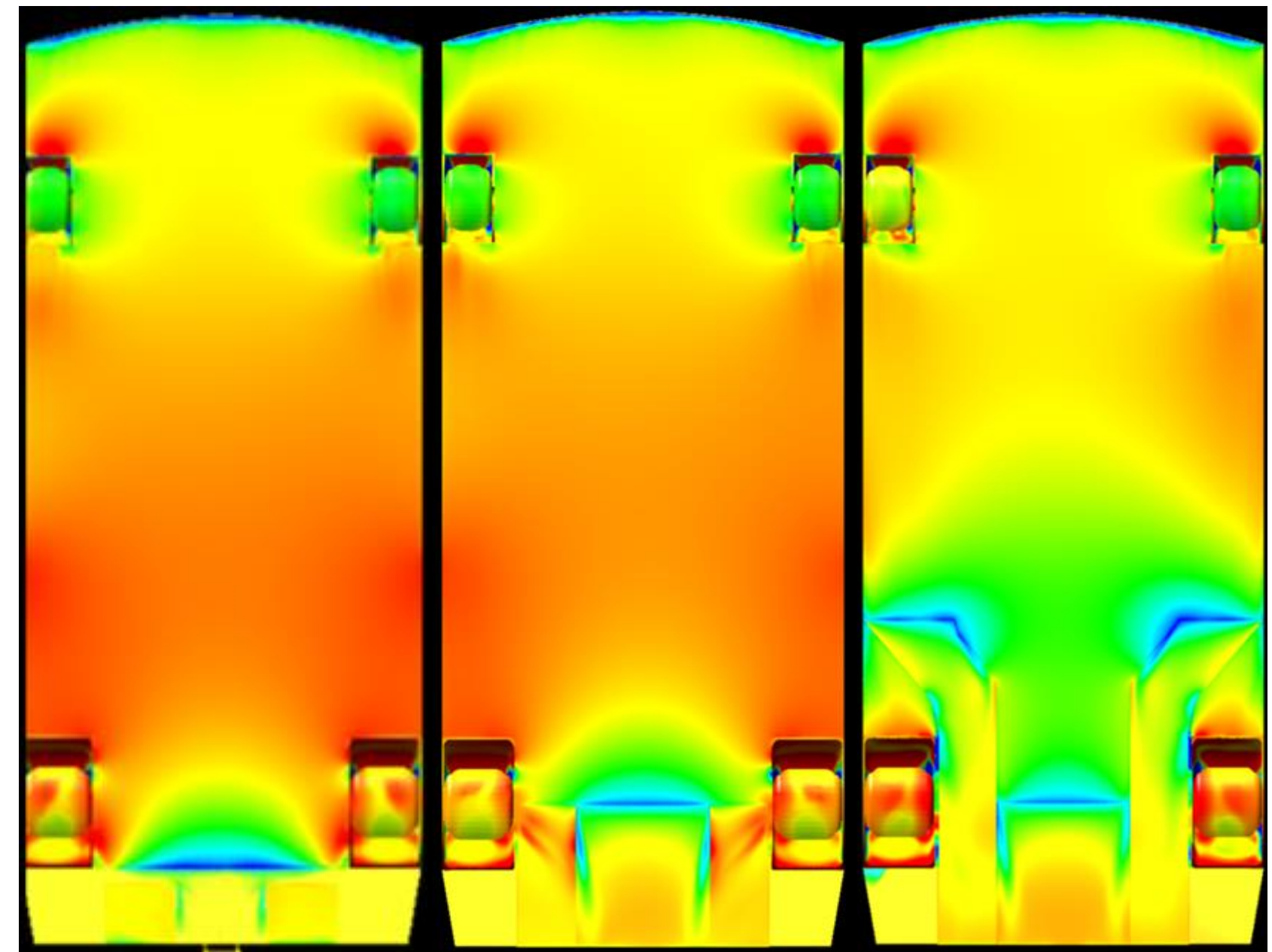
Baseline Results Comparison

CFD results compared to provided TotalSim data (60mm ride height)

- **0.467 Cd** – with a 0.01 Δ Cd to TotalSim data
- **0.350 -Cl** – with a 0.015 Δ Cl to TotalSim data
- **43.96% Balance** (% front) – with a Δ balance% of 0.13% to TotalSim data

Diffuser Centre Section Development

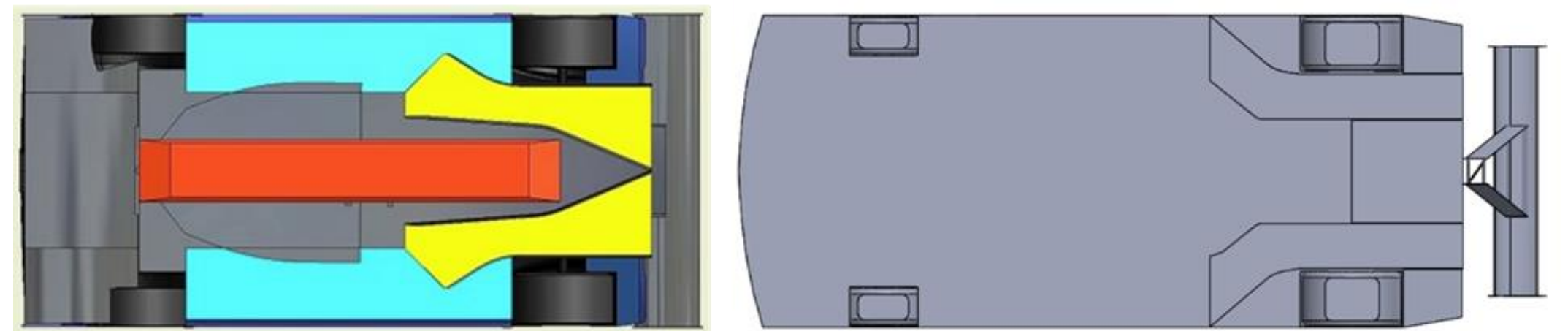
- Diffuser angle study: **8°** performed the best
- Diffuser overhang study: **0mm** performed the best
- Diffuser kickpoint study: not performed due to packaging limitations



Pressure contours of underbody. (from left to right, initial model with no diffuser, optimal design after centre section study, optimal design after side tunnel study)

Diffuser Side Tunnel Development

- Diffuser angle study: **8°** performed the best
- Diffuser kickpoint study: **1000mm** ahead of rear wheel axle performed the best
- Diffuser overhang study: **125mm** performed the best

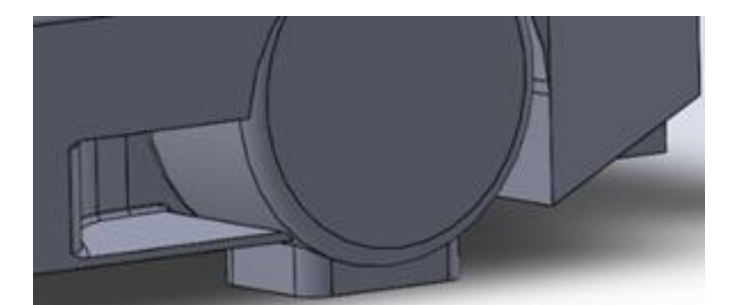
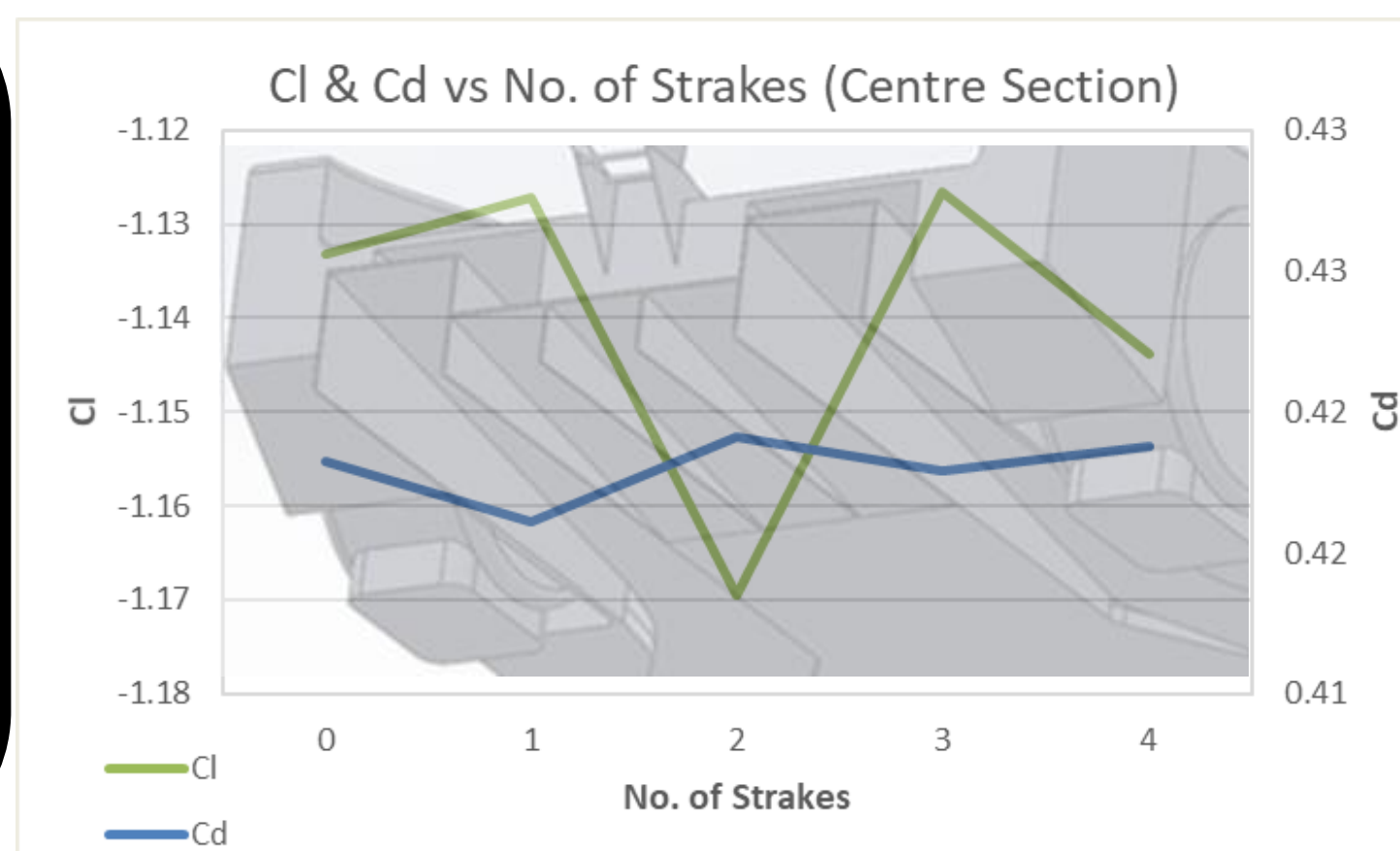


LMP1 & LMP2 underbody regulation boxes after the 2004 regulation change (left) and side tunnel diffuser design inspired by these regulations working around the packaging limitations (right). (Fuller, 2004)

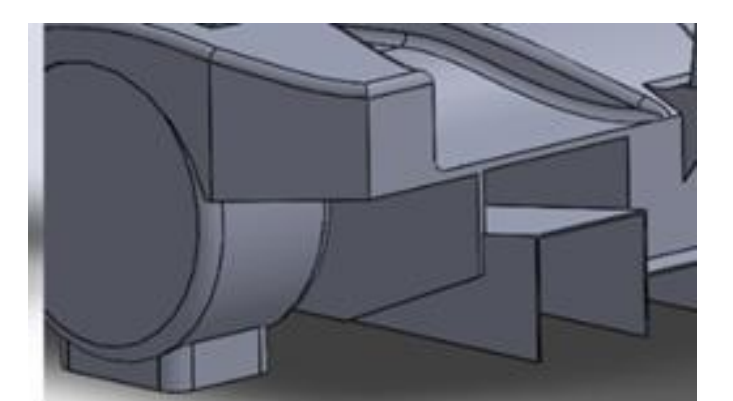
Strake Studies

Strake studies for the central section and side tunnels were performed separately.

- Centre section: **2 strakes** equally spaced from each other outperformed the 1, 3 and 4 strake setups
- Side tunnels: 3 strake designs with 1 & 2 strake configurations were tested (6 in total), non of which performed better than the initial (empty) side tunnels



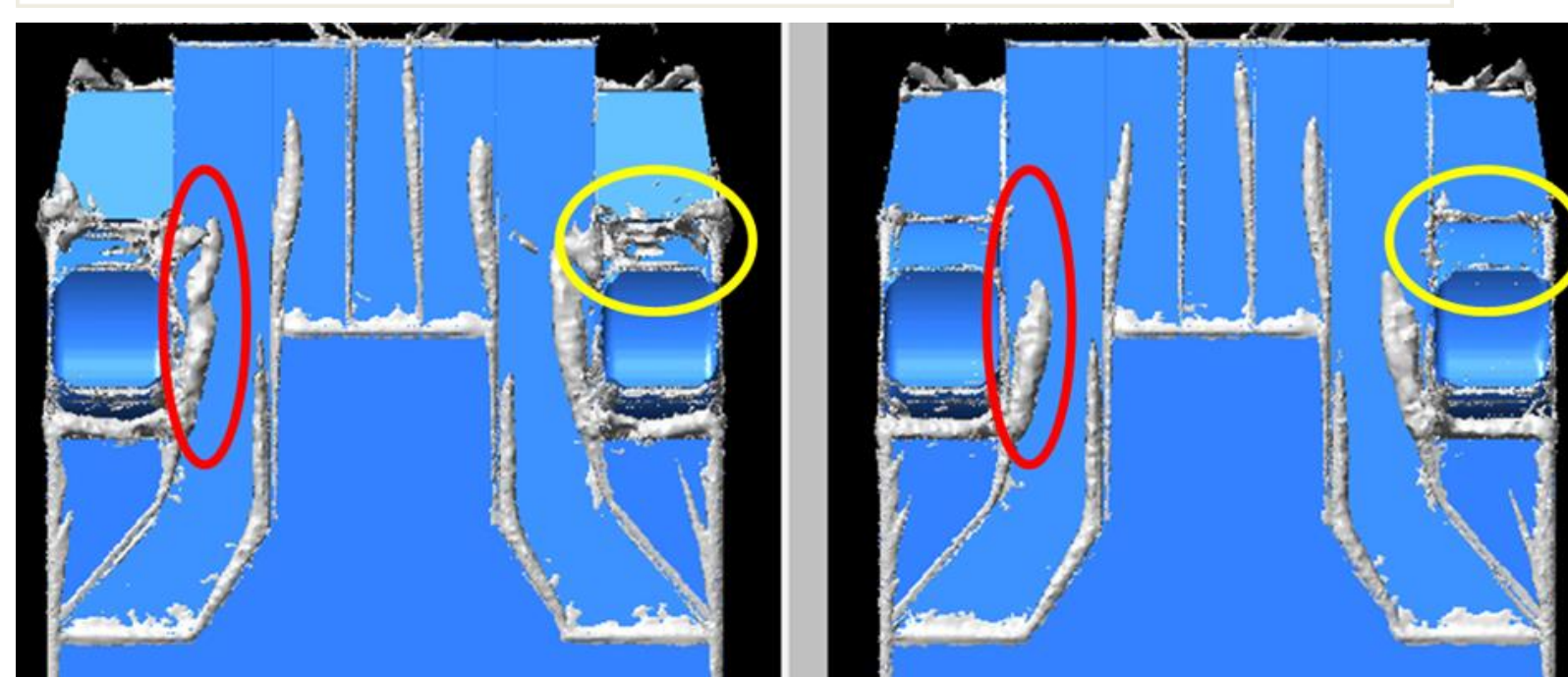
Tyre shelf



Wheel well cutaway

Tyre Squirt Reduction Study

- **Tyre shelf** study: increased tyre squirt, reducing diffuser performance
- **Wheel well cutaway** study: reduced pressure in wheel well (like louvres), reducing the effect of tyre squirt, enhancing overall diffuser performance



Vorticity comparison of design before (left) and after (right) wheel well cutaway. Red circle: uninterrupted outer side tunnel wall vortex. Yellow circle: Reduced turbulence behind rear tyre

Final Results

Final optimal diffuser configuration results compared to initial model without diffuser at 35mm ride height

- **0.418 Cd** – Increase of **0.002 Cd**, equivalent to <2N of drag at 35m/s
- **1.342 -Cl** – Increase of **0.922 -Cl**, equivalent 880N of extra downforce at 35m/s
- **58.66% Balance** (% front) – **11%** further rearwards

References

McBeath, 2017
Katz, 2006
ANSYS, 2012
Cooper, 1998
Lanfrut, 2005
MIRA, 2018
Toet, 2017
BRSCC, 2018
MotorsportUK, 2018

