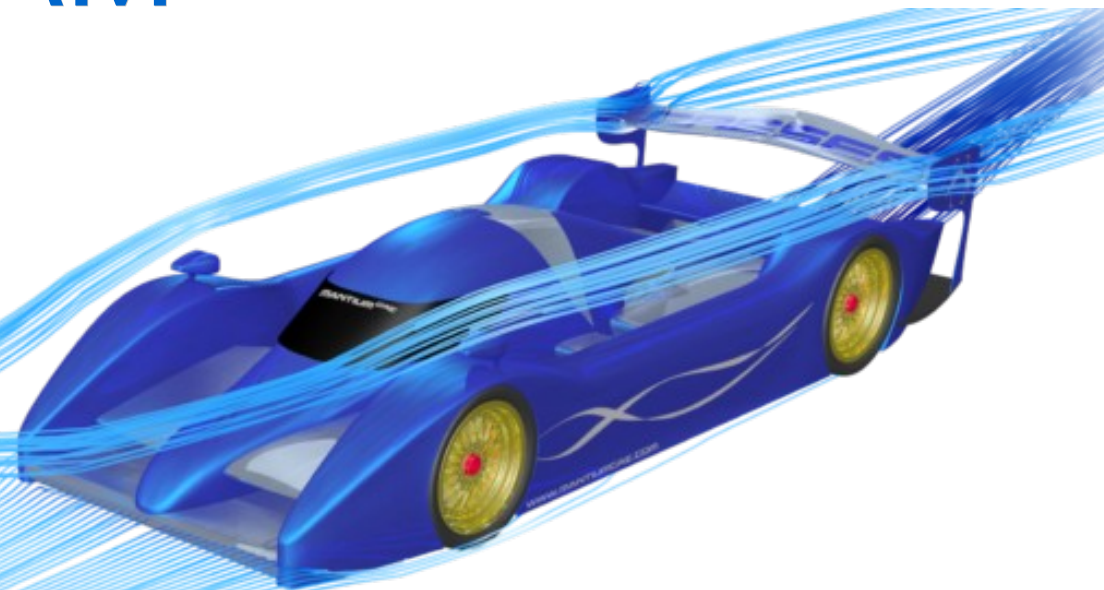


MANTIUM *CHALLENGE*

A virtual race car championship using OpenFOAM

André Zimmer

a.zimmer@MantiumCAE.com



Introduction

What is MVRC:

- The **Mantium Virtual Race car Challenge**
- CAD models are submitted for each race by each team
- CFD simulations of the cars are run
- A lap time simulator is used to determine the fastest car
- The fastest car wins

www.MantiumChallenge.com

Discussion on F1 Technical



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Key 2019 Threads
by **turbof1** » 30 Nov 2015, 13:07 » in General chat

2

25582

by **turbof1**
23 Jan 2019, 11:49

Forum guide: read before posting
by **Steven** » 23 Dec 2007, 14:54 » in General chat

1

75866

by **Steven**
26 May 2010, 00:10

Topics

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[MVRC] Mantium Virtual Racecar Challenge 2018 33
by **LVDH** » 09 Jul 2018, 09:39

738

42844

by **CAEdevice**
25 Feb 2019, 21:17

1 ... 46 47 48 49 50

[MVRC] Mantium Virtual Racecar Challenge 2017 9
by **cdsavage** » 20 Jun 2017, 21:21

1259

71759

by **etsmc**
09 Jul 2018, 06:52

1 ... 80 81 82 83 84

[MVRC] Mantium Virtual Racecar Challenge 2016 20
by **cdsavage** » 16 Aug 2016, 12:03

1363

73905

by **cdsavage**
20 Jun 2017, 21:21

1 ... 87 88 89 90 91

[KVRC] Khamsin Virtual Racecar Challenge 2016 24
by **cdsavage** » 25 Aug 2015, 17:54

1480

81566

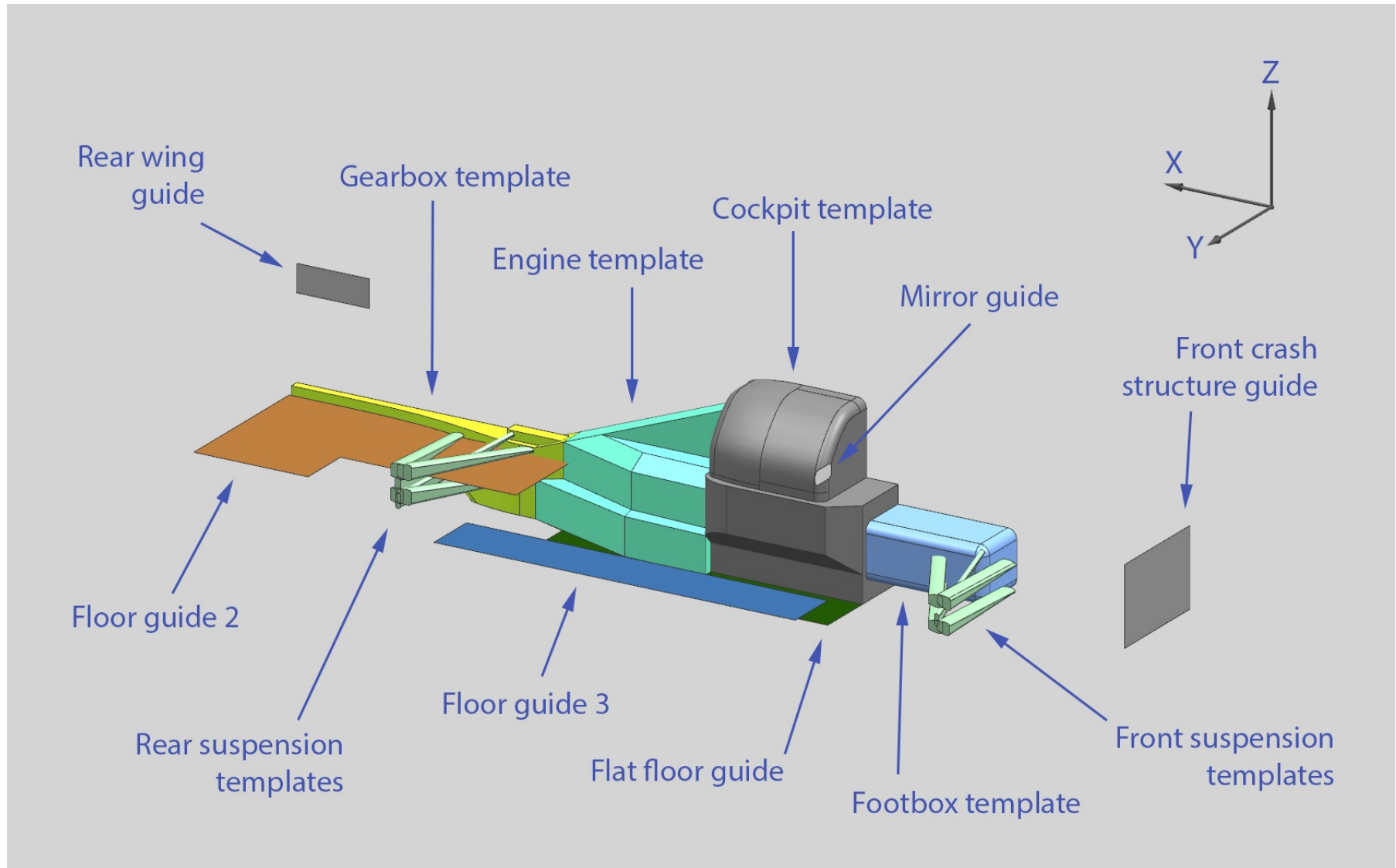
by **cdsavage**
17 Aug 2016, 21:43

1 ... 95 96 97 98 99

MVRC 2018 Race Calendar

| Date | Race |
|-----------------------------|------------|
| August 12 – August 26 | Le Mans |
| September 16 – September 30 | Sepang |
| November 11 – November 25 | Sao Paulo |
| January 27 – February 10 | Daytona |
| February 24 – March 10 | Pikes Peak |

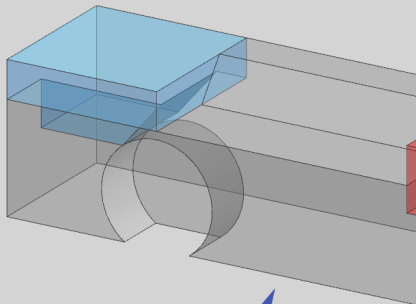
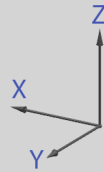
Rules



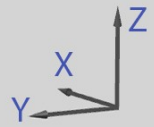
Rules

Rear wing volume

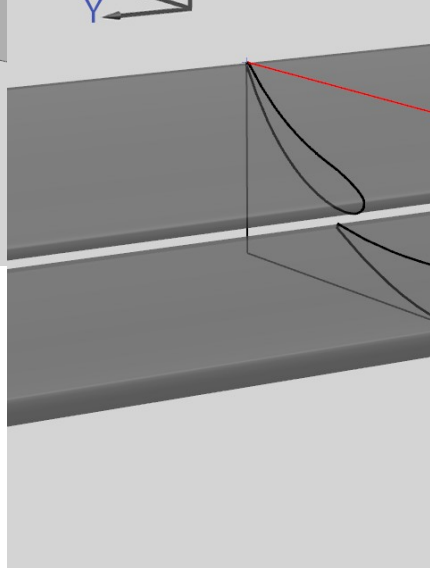
Visibility volume



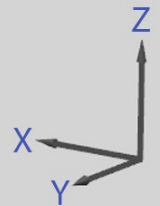
Bodywork volume



$\leq 400\text{mm}$



$A \geq 25,000\text{mm}^2$

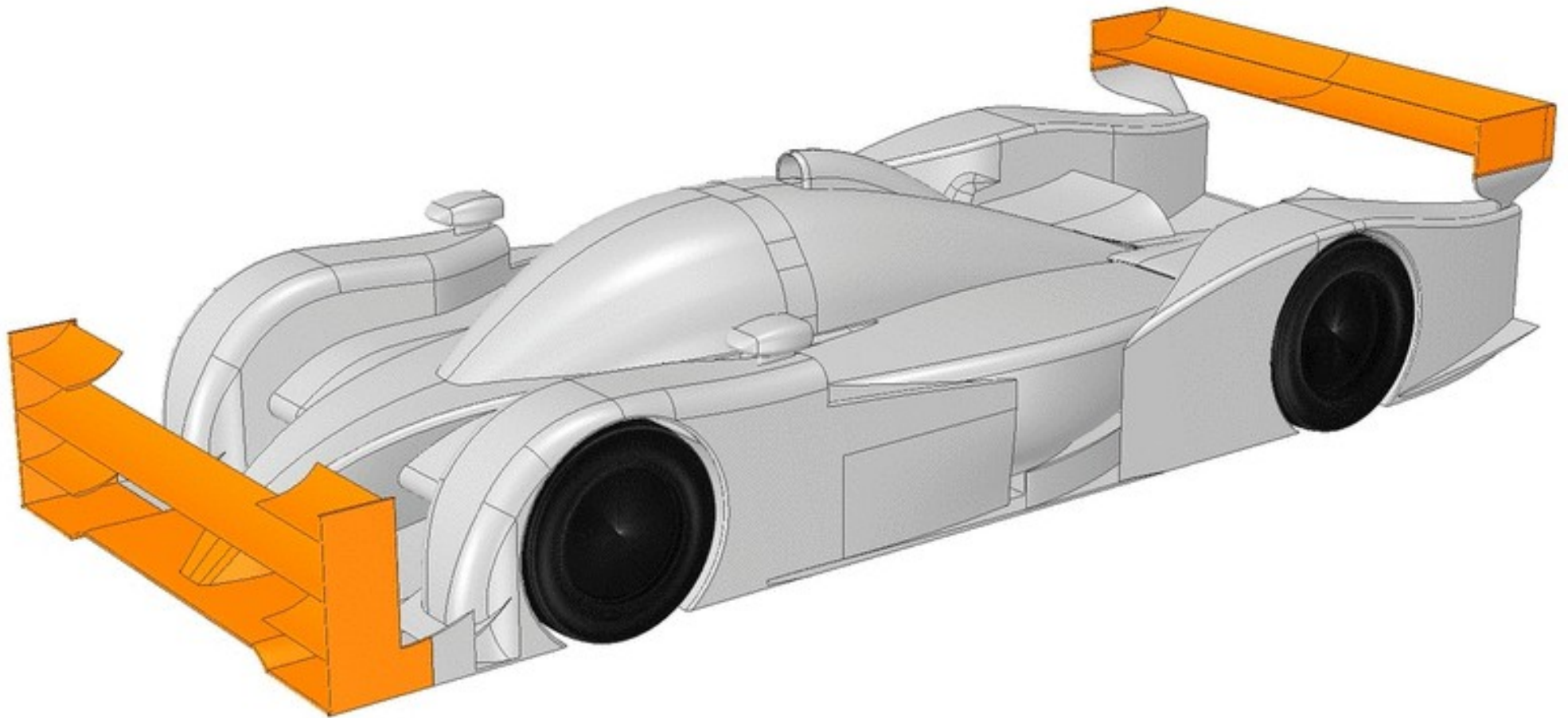


750mm from FWCL

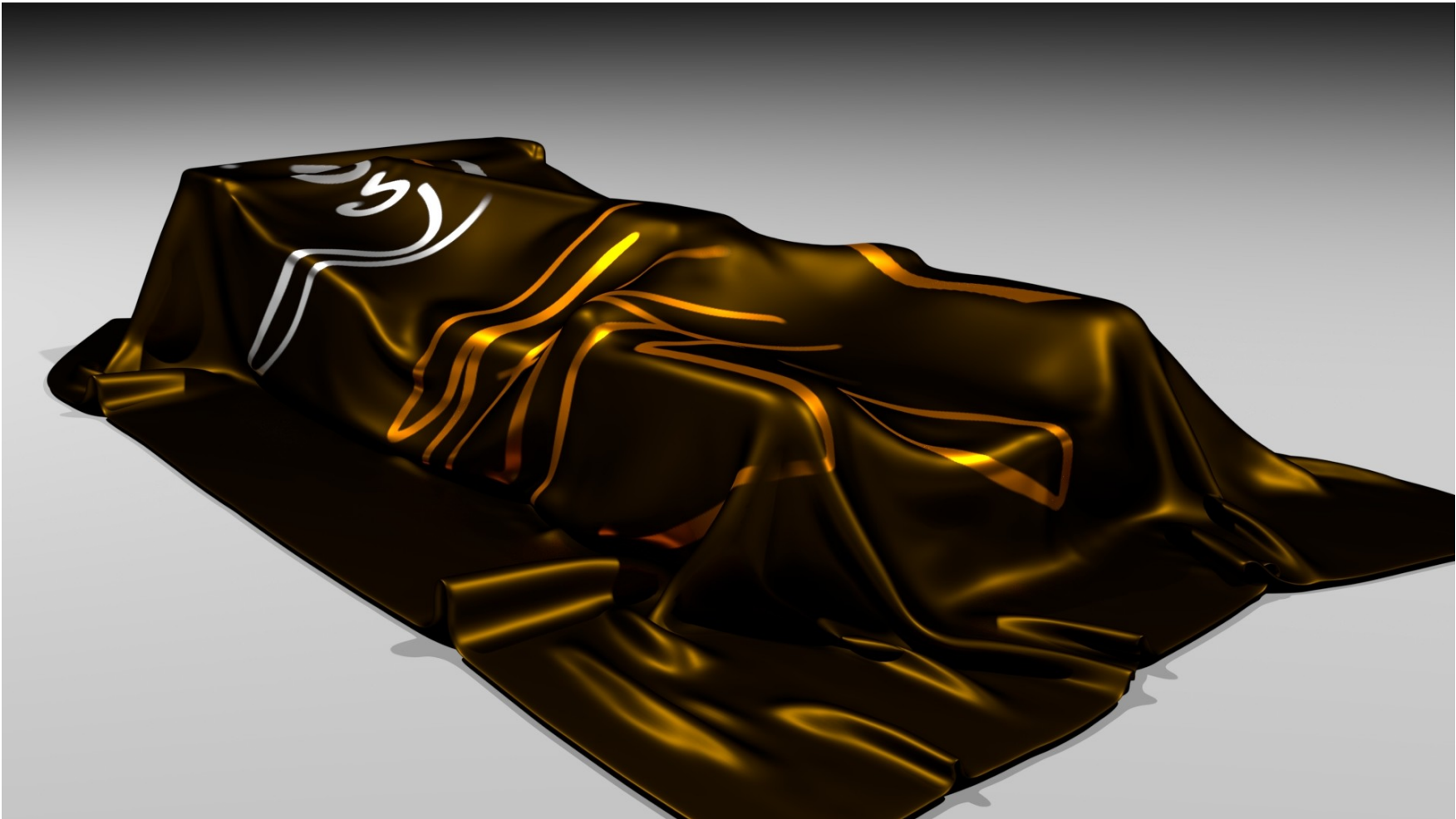
50mm

300mm

Some Cars



Some Cars



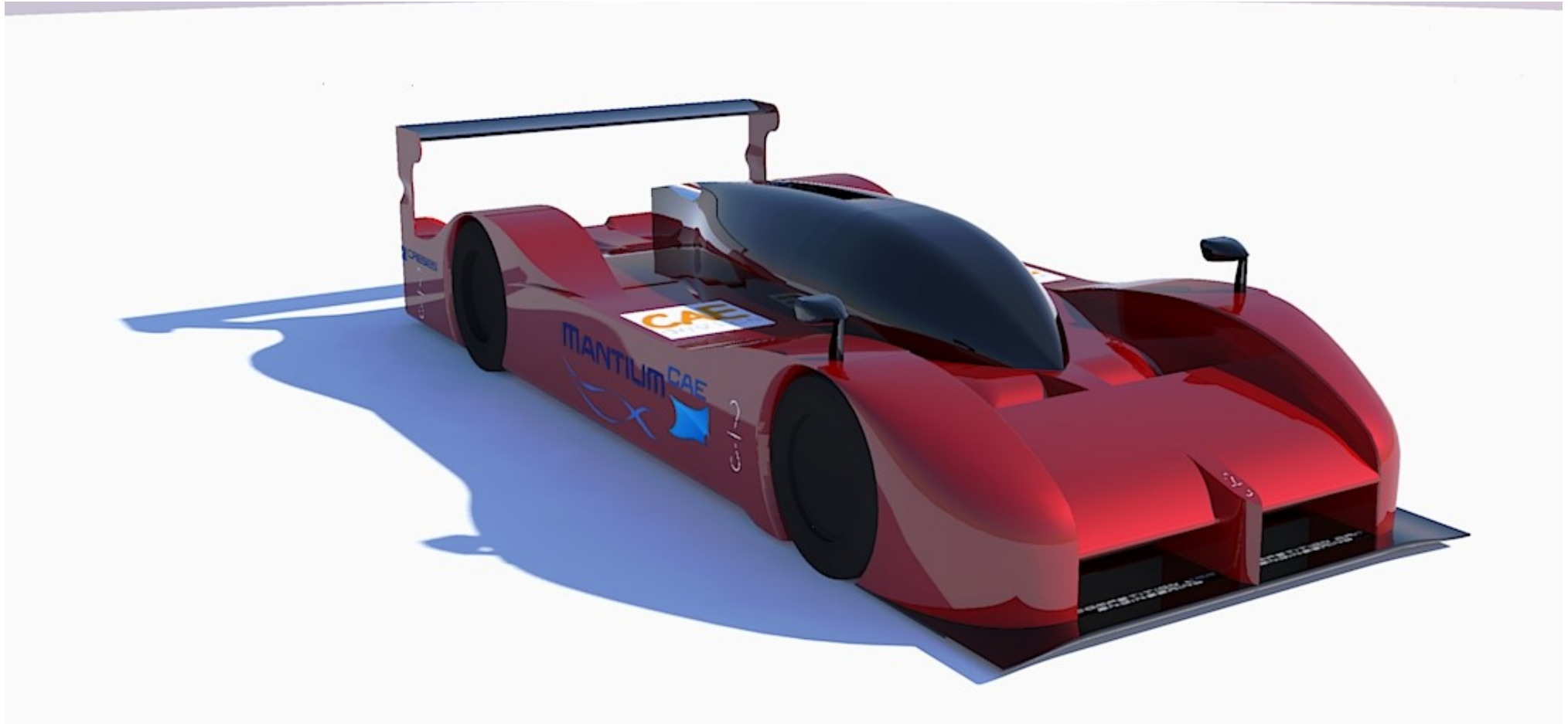
Some Cars



Some Cars



Some Cars



Some Cars



Software

Software used for the Challenge:

MANTIUM *FLOW*

VIRTUAL STOPWATCH
COMPETITION BAR
ENGINEERING

Software

Software used for the Challenge:

MANTIUM *FLOW*

VIRTUAL STOPWATCH
COMPETITION CAR
ENGINEERING

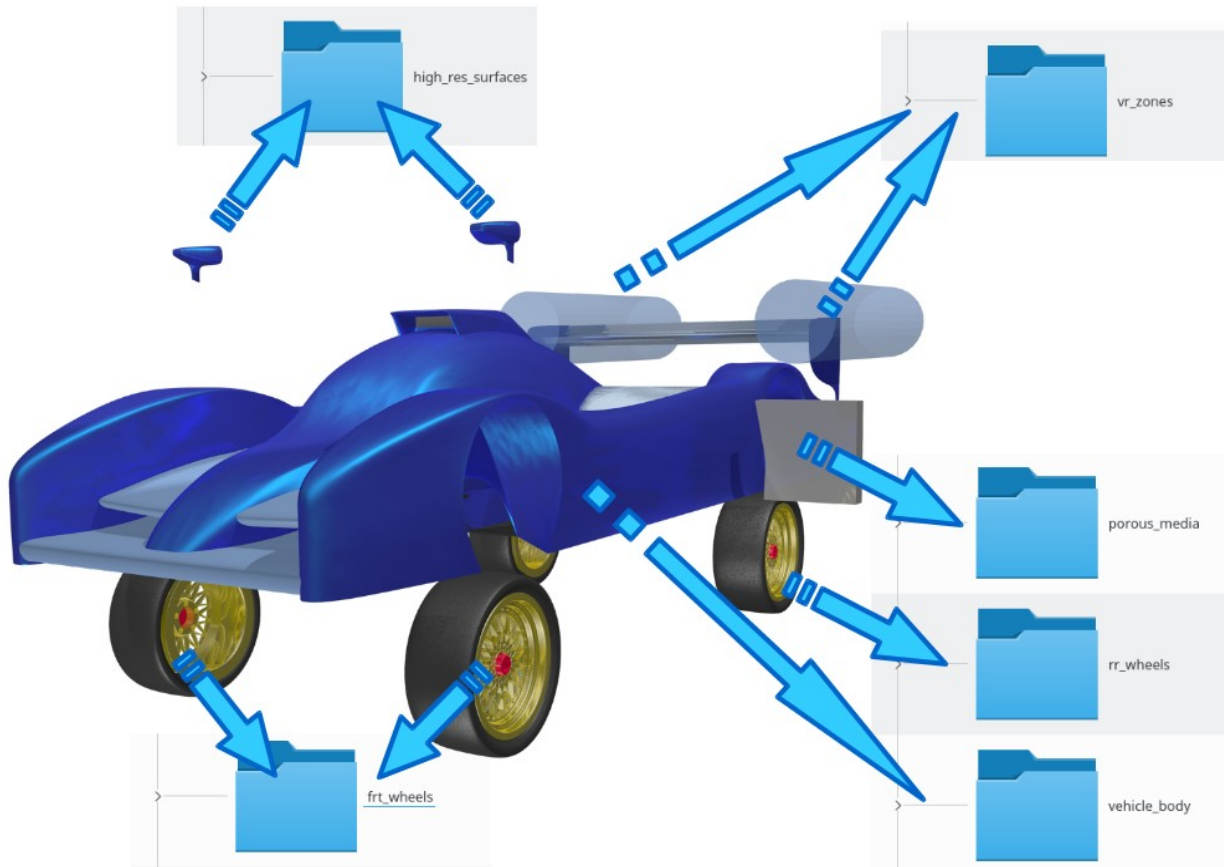
MANTIUM^{FLOW}

A CFD Software developed by MantiumCAE:

- Robustness
- Repeatability
- Minimal amount of user error
- Comparability of Results



MANTIUM^{FLOW}



- input_files
 - geometry
 - default_wall
 - frt_wheels
 - high_res_surfaces
 - low_res_surfaces
 - monitoring_surfaces
 - MRF_regions
 - porous_media
 - rotating_geometries
 - rr_wheels
 - special_bc
 - special_zones
 - vehicle_body
 - vr_zones
 - VR_03_lhs.stl
 - VR_03_rhs.stl
 - VR_04_lhs.stl
 - VR_04_lower.stl
 - VR_04_rhs.stl
 - VR_04_top.stl
 - WT
 - solver_settings.ini

MANTIMUM^{FLOW}

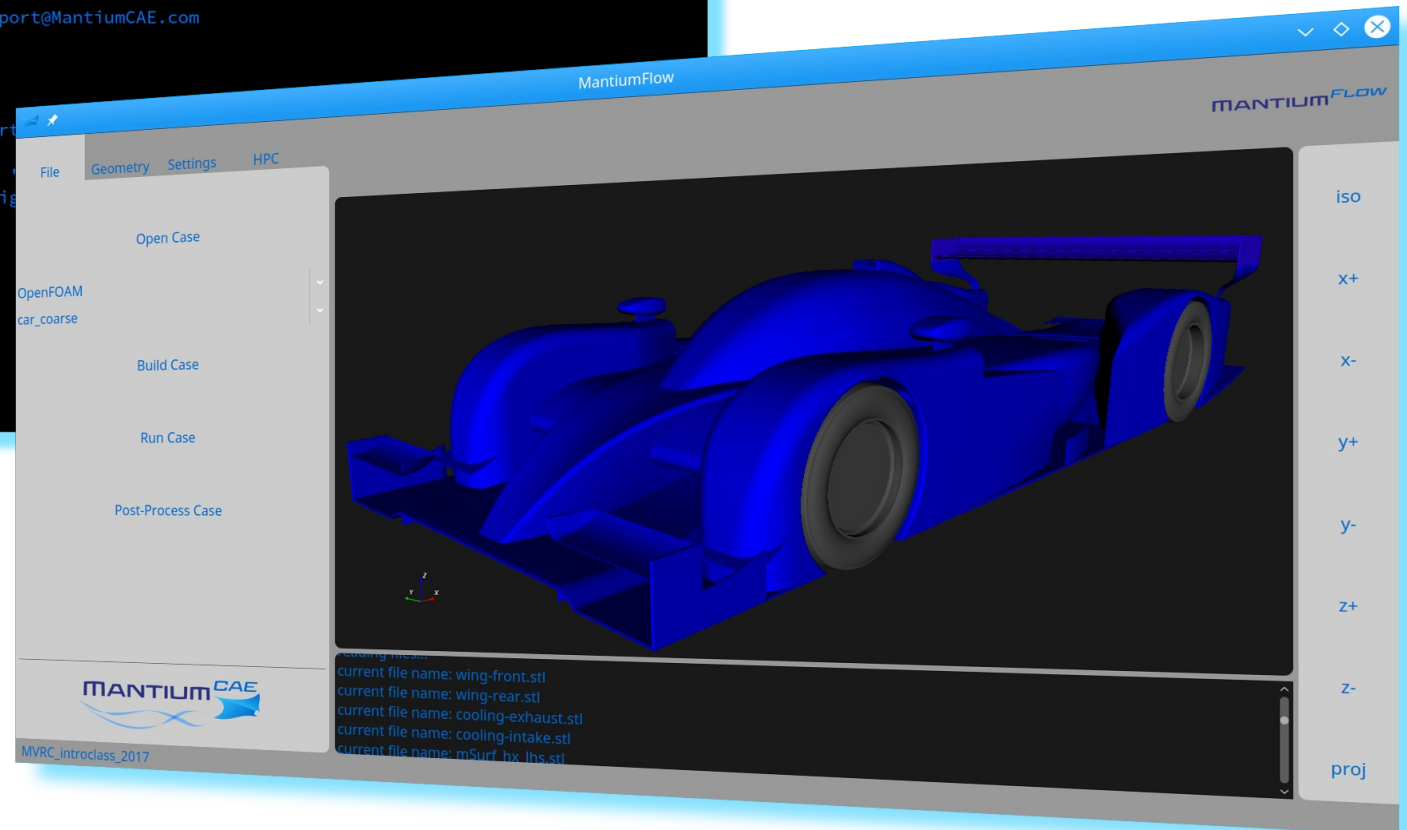
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MANTIMUMFLOW
Version Beta

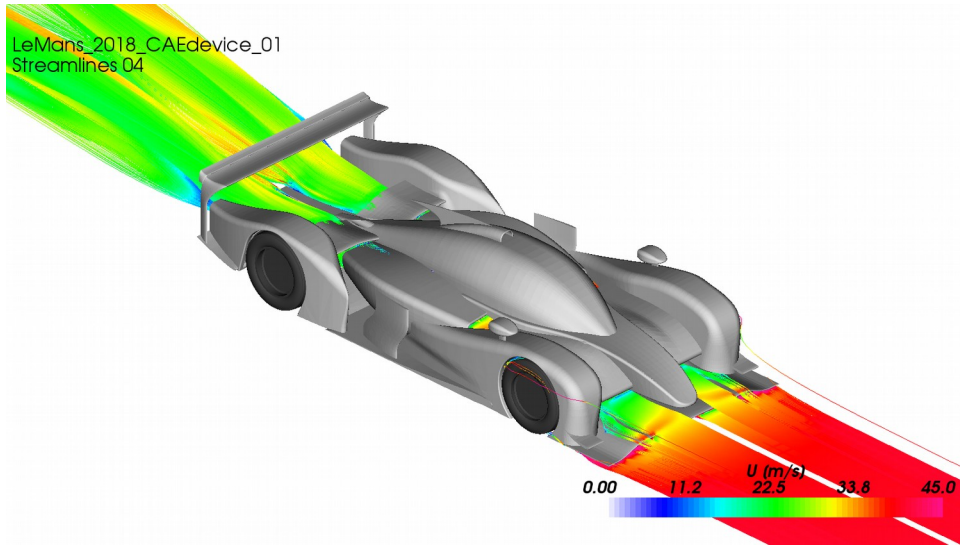
By MantiumCAE, for support please email to support@MantiumCAE.com
www.MantiumCAE.com
    
```

```

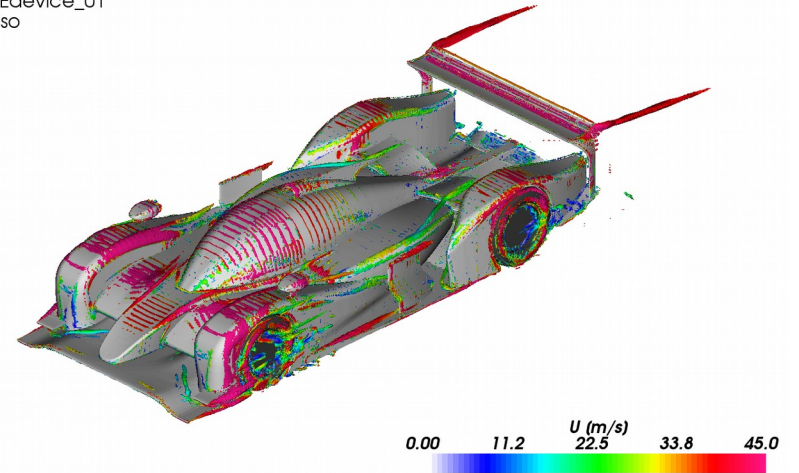
Case folder: /home/andre/large_disk/MVRC/support
checking folder structure...
Detected folders in geometry: ['vehicle_body', 'high']
Valid MantiumFlow folders: ['vehicle_body', 'high']
reading files...
current file name: vehicle_body.STL
current file name: rear_wing.STL
current file name: hx_left.STL
current file name: hx_right.STL
current file name: Rear_wheel_SX.stl
current file name: Rear_wheel_DX.stl
current file name: Front+wheel_DX.stl
current file name: Front_wheel_SX.stl
current file name: engine_in.STL
    
```



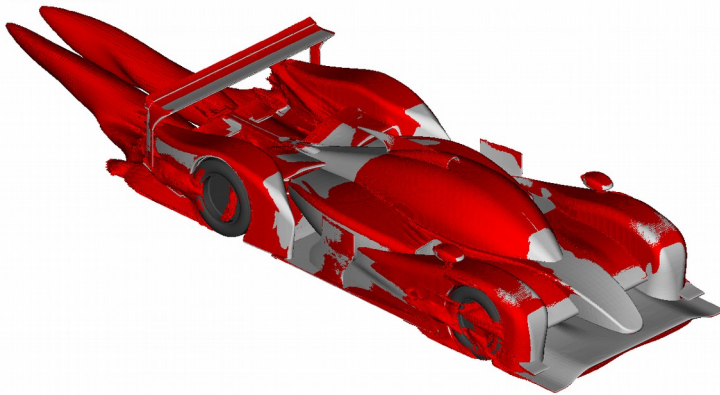
MANTIUM^{FLOW}



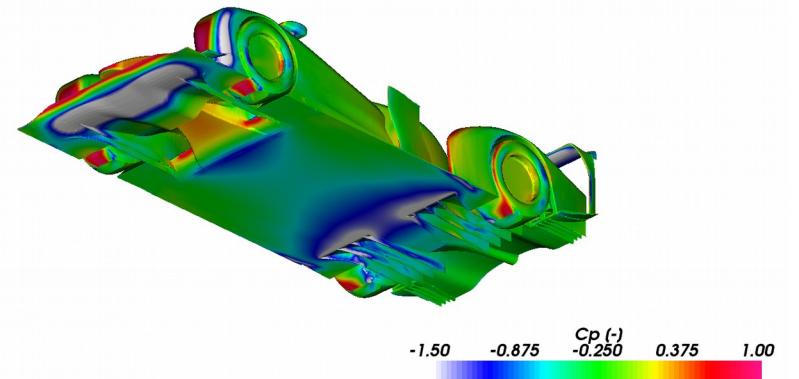
LeMans_2018_CAEdevice_01
Lambda2=35000 Iso



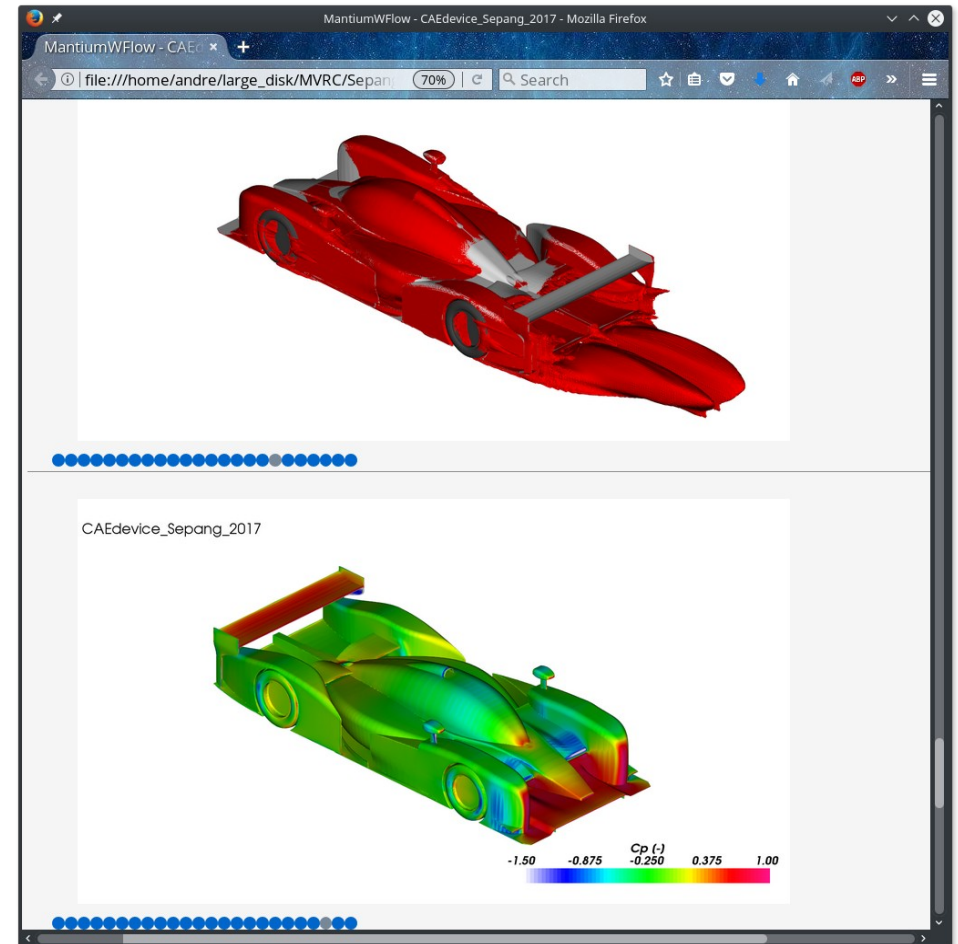
LeMans_2018_CAEdevice_01
ptot=0 isosurface



LeMans_2018_CAEdevice_01



MANTIMUM^{FLOW}



Software

Software used for the Challenge:

MANTIUM *FLOW*

VIRTUAL STOPWATCH
COMPETITION BAR
ENGINEERING

Virtual Stopwatch

VIRTUAL STOPWATCH

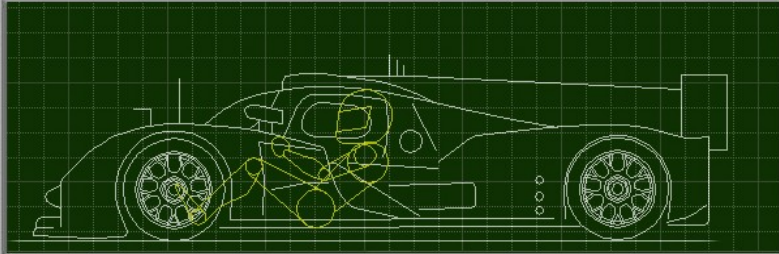
| | |
|--------------------------------|-----------------------------------|
| CHASSIS LAYOUT: LMP1 | REAR TYRE/WHEEL SIZE: 365-18" |
| CONSTRUCTION: Carbon Monocoque | TYRE TYPE: Medium Compound Slicks |
| BODY STYLE: LMP1 Car | WHEEL TYPE: Alloy |
| UNDERFLOOR AERO: - | WHEEL RIM WEIGHT REDUCTION: - |

| | |
|---|---------------------------------|
| ENGINE: 3.0l petrol 540bhp + 144bhp ERS | DIFFERENTIAL RATIO: 3.2 : 1 |
| GEARBOX: Xtrac 8 ratio Seamless | DIFFERENTIAL RAMP ANGLES: 45/85 |
| | TRANSMISSION TYPE: RWD |

WHEELBASE: 3.0 m

CFD RESULTS

| | | | |
|--------------------|--------------------|---------------------|-----------------------------|
| TEST SPEED: 100mph | Cd A: 1.3 | Cd A: 4.5 | COP behind front Axle: 1.65 |
| | Engine Intake: 0.0 | Engine Exhaust: 4.5 | Cooling Flow: 3.0 |
| | | m ³ /sec | |



| |
|------------------------------------|
| DRIVER MASS: 80 |
| PROXIMITY TO CORNERING LIMIT: 100% |
| FUEL/BALLAST CARRIE: 10kg |

PERFORMANCE TRIAL: Nurburgring

TARMAC GRIP FACTOR: 1

START

0

http://www.competition-car-engineering.com/MVRC_Timing.htm

Virtual Stopwatch

VIRTUAL STOPWATCH

CHASSIS LAYOUT: LMP1
 CONSTRUCTION: Carbon Monocoque
 BODY STYLE: LMP1 Car

REAR TYRE/WHEEL SIZE: 365-18"
 TYRE TYPE: Medium Compound Slicks
 WHEEL TYPE: Alloy

WHEELBASE

3.0 m

CFD RESULTS

TEST SPEED

100mph mph

Cd.A

1.3 m²

Cl.A

4.5 m²

COP behind front Axle

1.65 m

Engine Intake

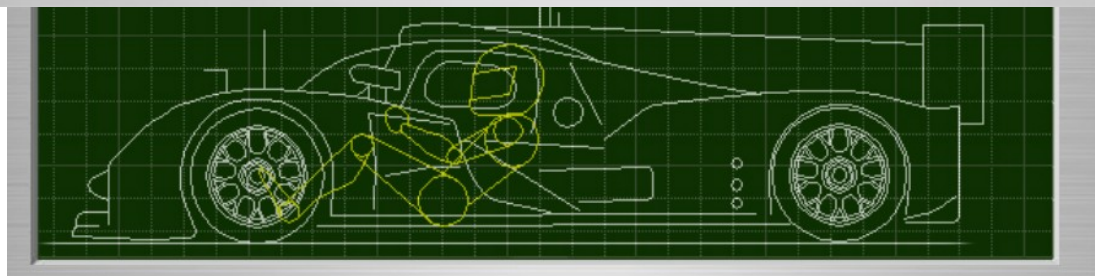
0.0 Pa.m²

Engine Exhaust

4.5 Pa.m²

Cooling Flow

3.0 m³/sec



Virtual Stopwatch

DRIVER MASS: 80 kg

PROXIMITY TO CORNERING LIMIT: 100%

FUEL/BALLAST CARRIED: 10kg

PERFORMANCE TRIAL: Le Mans

TARMAC GRIP FACTOR: 1

START

208.3secs

Total mass incl driver= 950 kg
 Front:Rear Weight Distribution= 45 : 55
 Wheelbase = 3.0m
 Track Width = 1.64m
 Wheel frequency= 2.9Hz
 Damping Ratio = 0.7
 Roll Stiffness distribution= 50 : 50
 Downforce distribution= 45 : 55
 Gear Ratio 1 = 2 (104mph)
 Gear Ratio 2 = 1.8 (116mph)
 Gear Ratio 3 = 1.6 (130mph)
 Gear Ratio 4 = 1.4 (149mph)
 Gear Ratio 5 = 1.25 (166mph)
 Gear Ratio 6 = 1.1 (189mph)
 Gear Ratio 7 = 1.0 (208mph)
 Gear Ratio 8 = 0.91 (215mph)
 20% more DF and Drag = 1.41 secs
 20% less DF and Drag = -1.5 secs
 20% less Drag = -3.8 secs
 20% More DF = -2.34 secs
 Engine Power = 100 %

Virtual Stopwatch



www.competition-car-engineering.com



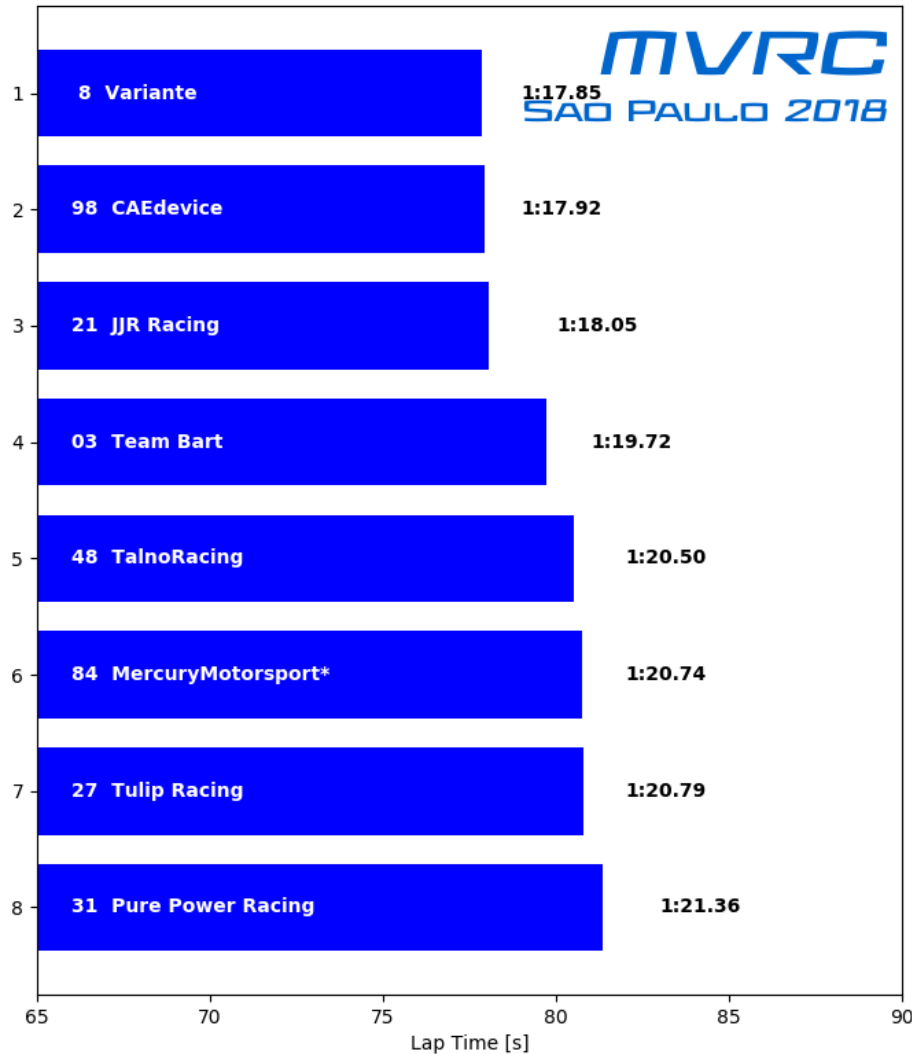
www.competition-car-engineering.com

Results last Race

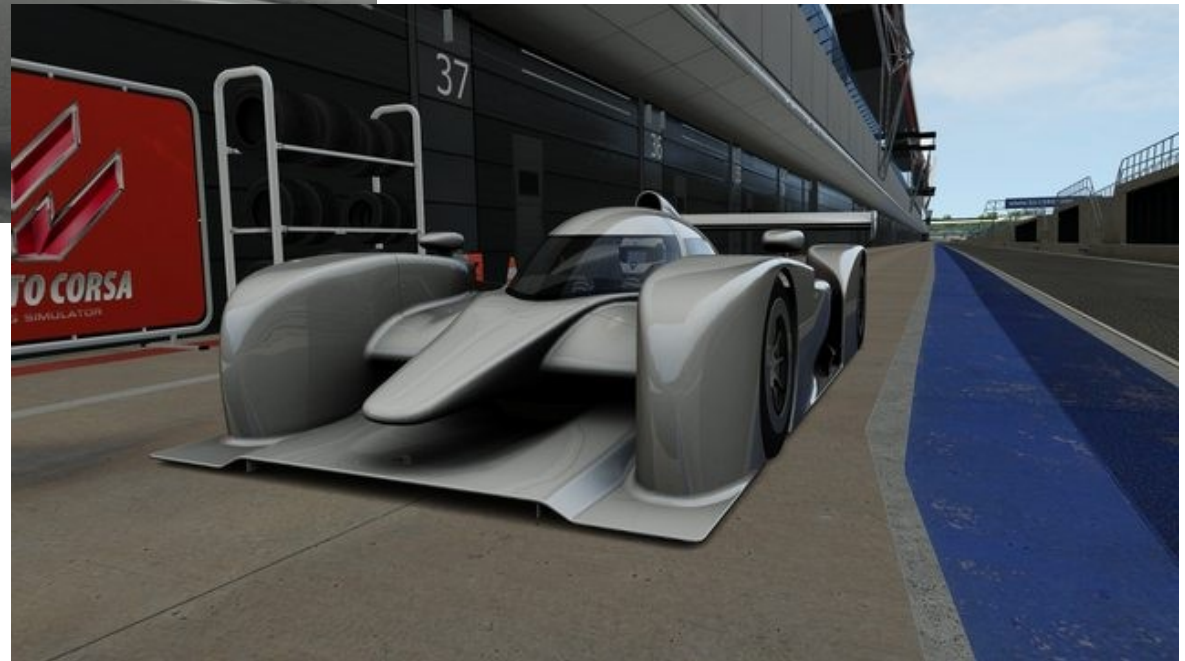


<https://www.youtube.com/watch?v=EBsK1h-Cozg>

Results last Race



MVRC Future



MVRC Future

- 2019 the Le Mans type cars are retiring
- 2019 will see F1 style cars
- Join the championship as competitor
- Join the championship as staff member
- Join the championship as CFD journalist
- An HPC sponsor would be very welcome!

MANTIUM^{CAE}

Thank you for your attention!

Special thanks also go out to Chris, Richard and the MVRC sponsors:

