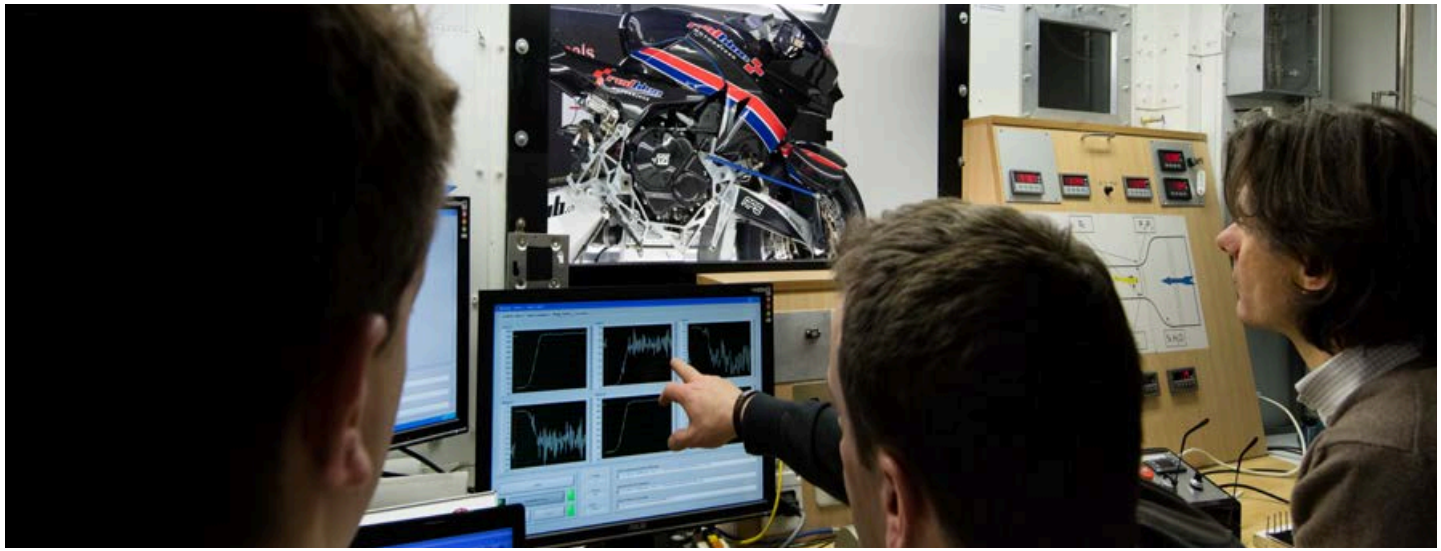

HEPIA GENEVA WIND TUNNELS

A short presentation of the laboratory and the methodology used for motorsport aerodynamics

Patrick Haas, Prof. Ordinaire
Head of the fluid mechanics group (cmefe)
hepia Geneva Wind Tunnels

August 2018

L'avenir est à créer

hepia
Haute école du paysage, d'ingénierie et d'architecture de Genève

THE HEPIA SUBSONIC WIND TUNNEL

KTM Moto2 2017

- Test section: 2.0 m x 1.5 m
- Maximal speed: env. 280 km/h
- 6 component balances
- Measurement robot
- Visualization systems
- Thermal and cooling tests capabilities

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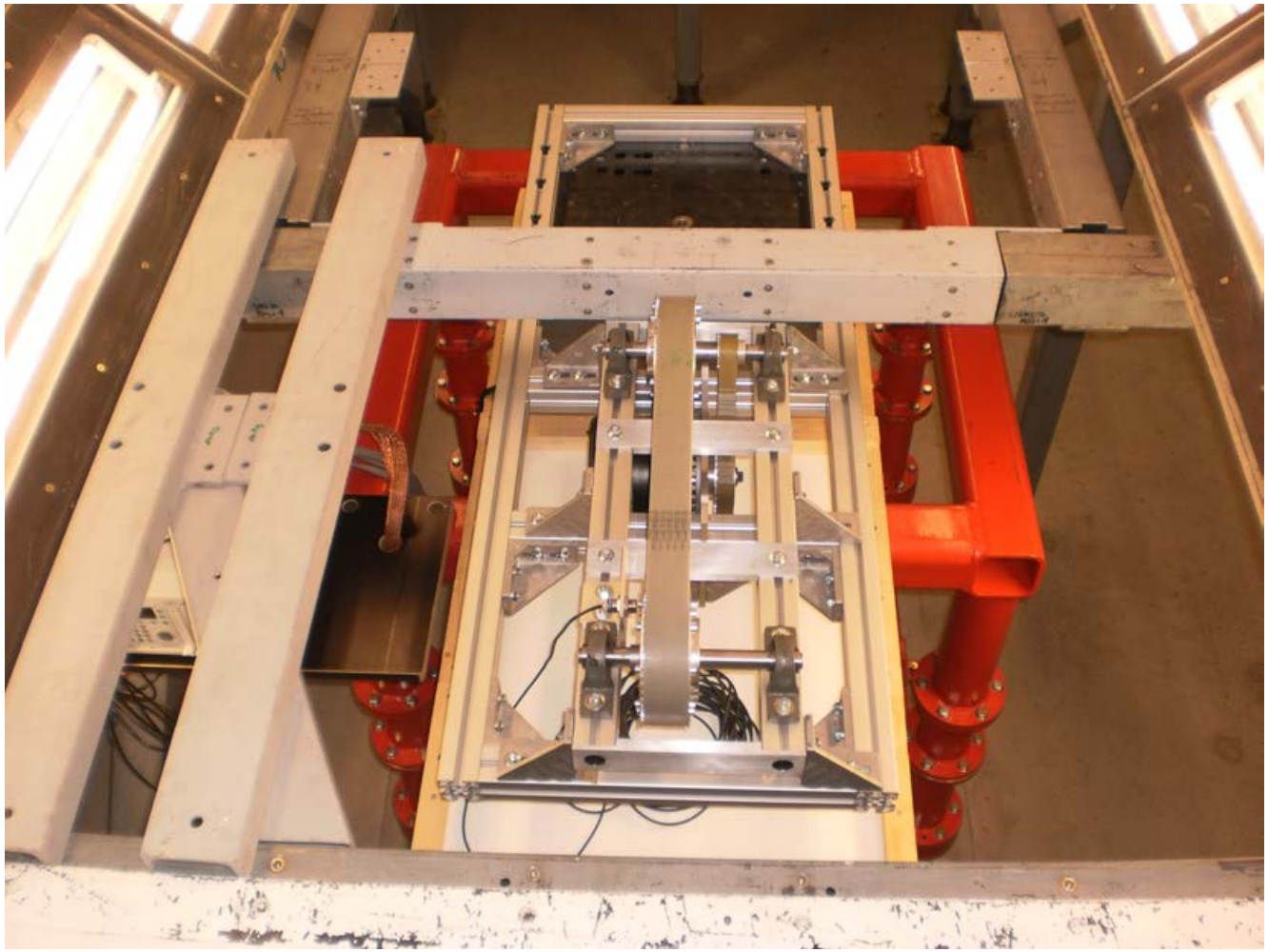
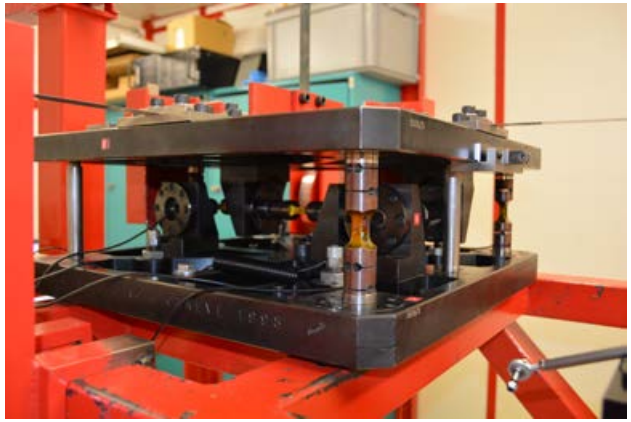
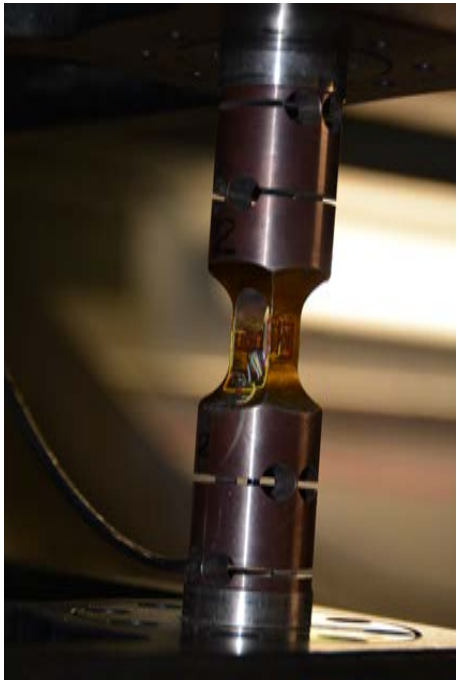
THE HEPIA SUBSONIC WIND TUNNEL

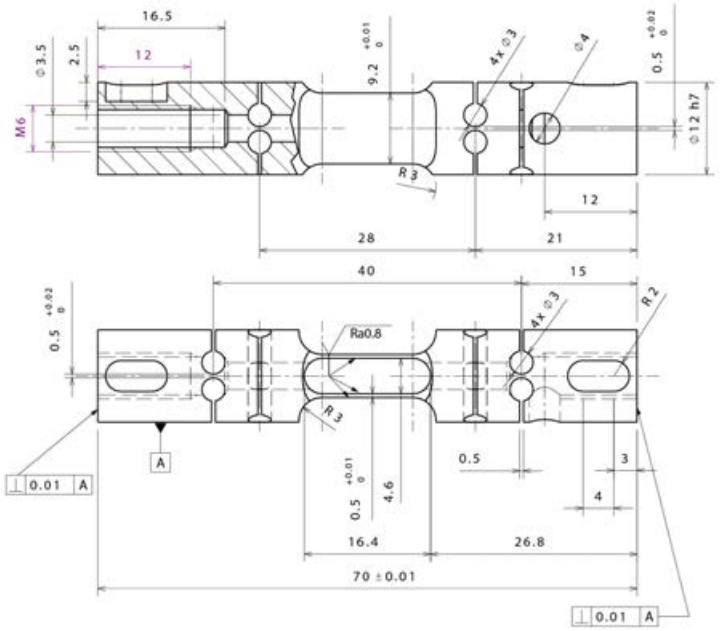


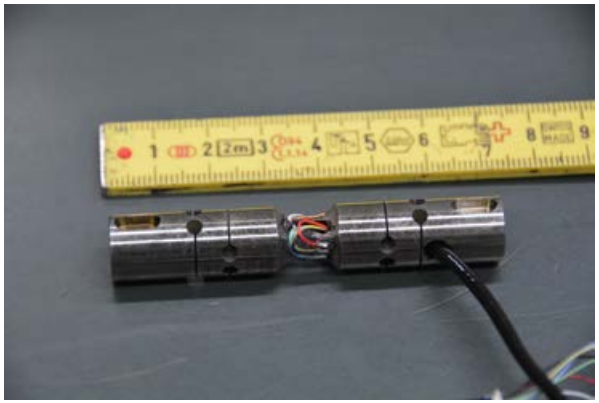
6 component aerodynamic balance with rolling belt

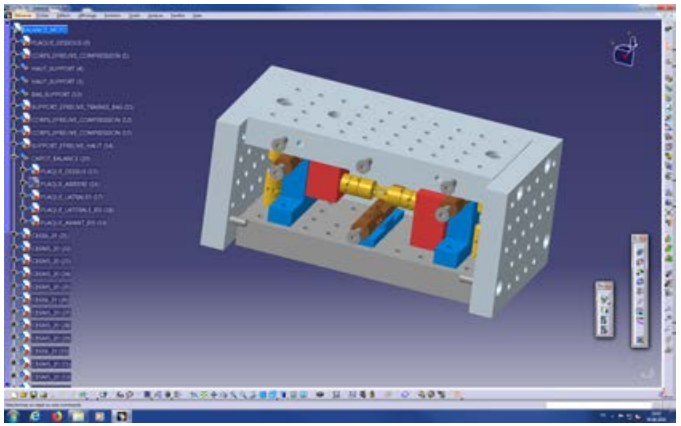
PRODUCTION AND CALIBRATION OF AERODYNAMIC BALANCES











3 or 6 component balances

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THE HEPIA SUBSONIC WIND TUNNEL

Heaters for the evaluation of thermal systems and cooling during aerodynamic tests

CALCULATION CLUSTERS

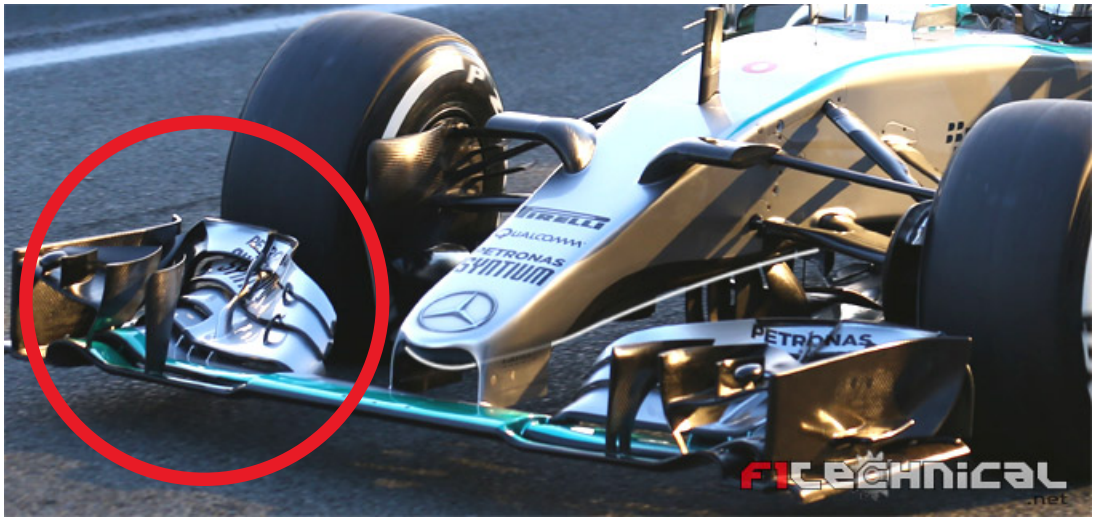
Baobab HPC :	Intel Sandy Bridge, 2'500 cores, 10 To RAM, infiniband (hepia + unige)
Gordias HPC :	ClusterVision, 224 cores, 448 Go RAM, infiniband
EoleC1-5 :	Oracle SUN, 44 cores, 132 Go RAM
EoleC6 :	Dell, 96 cores, 256 Go RAM
Workstations :	8 workstations Dell and HP 16 cores, 126 Gb RAM
Storage (NAS) :	2 x 70 To = 140 To with confidentiality management
CFD software :	ANSYS CFD Associate (industrial), Research and Teaching

MECHANICAL SPORTS AT HEPIA (REFERENCES)

- Egli Motorradtechnik (1985)
- Motos ROC Annemasse (1992)
- ASM Formula 3 (2006)
- Eco-marathon Shell : Consomini, Biomobile.ch (2003 - actual)
- Motostudent PoliTo Turin (2011-12)
- Moto2 NCS Rapid Inside Modena (2011)
- Audit of the Formula 1 teams (2010 – 2013) P. Haas, R. Putzu
- MotoGP Akira Kawasaki (2014 - 2015)
- Moto2 Tech3 (2014)
- Vyrus 986 M2 Wings (2016)
- Moto2 KTM (2016 – actual)
- Moto2 Garage Plus et Technomag CarXpert : Suter, Kalex, KTM (2014 - actual)
- Moto2 Geotechnology NTS project (2016 – actual)

Moto2 Tech 3 Mistral

WHAT CAN BE LEARNED FROM THE FORMULA 1 TEAMS ?



Mercedes AMG F1 WA06

Ferrari SF15T, 2015

How they use CFD technics :

- CFD show all flow variables everywhere in the domain without disturbing anything for all scales of space and time !

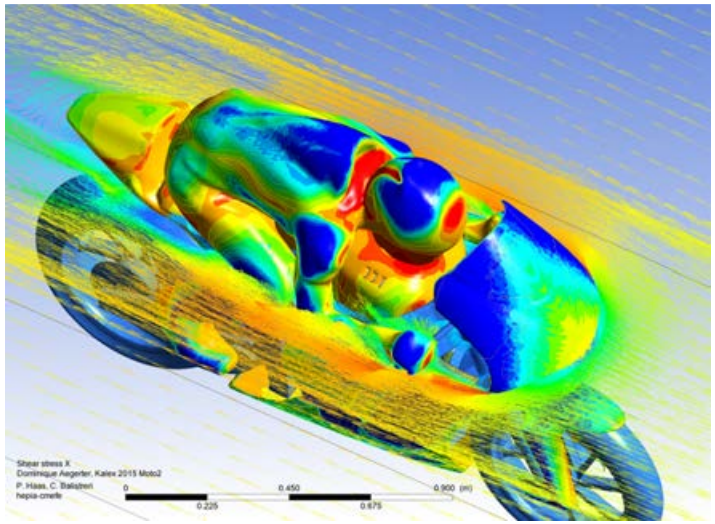
  Understanding of the flow behaviour → New ideas !

- Design optimization – Parametric studies

THE HEPIA GLOBAL METHODOLOGY

Since 2011, hepia uses with success a global methodology including 5 chapters :

1. **Full scale wind tunnel tests**
   - With riders, seat definition and position
   - CFD validation on the wind tunnel case
   - Continuity with experience (known values)



2. **Model wind tunnel tests (half-scale)**
   - Availability of the model all the year long
   - Size of the model for a correct aspect ratio (surface of the test section / surface of the model)
   - Costs (more days to work!)

3. **Simulations (CFD)**
   - Flow behaviour understanding
   - New ideas
   - Motor cooling and thermal studies

THE HEPIA GLOBAL METHODOLOGY

4. **On track measurements**
   - Instrumented motorcycle
   - Full scale
   - In open space (real case)
   - Torque measurements at the wheel
   - Work done on a MotoGP for studying the blocage in the wind tunnel at hepia.

5. **Race data logger measurements**
   - Study of the data obtained during the races

Tom Lüthi 2017

- Recognize each method for their strengths and weaknesses
- Use a global methodology with only one objective: Increasing the results on the track !

HEPIA MOTO2 AERODYNAMIC PROGRAM
RESULTS

Aerodynamic resistance:

$$F = \tfrac{1}{2} \rho \, SCx \, V^2$$

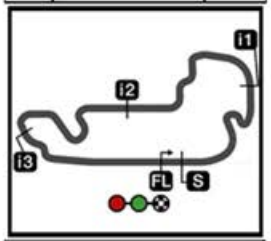
x

		SCx
Moto2 Kalex Aegerter 2015 (with hepia work)		
Simulations CFD	:	0.230
WT full scale (corrected)	:	0.252
WT original Kalex (without hepia work)	:	0.279
Moto2 Kalex Aegerter 2016 (with hepia work)		
WT full scale (corrected)	:	< 0.245
WT original Kalex (without hepia work)	:	0.269
Moto2 Suter Aegerter 2014 (with hepia work)	:	0.262
Moto2 NCIS 2011 original	:	0.320

ON THE TRACK...

- The swiss Moto2 is offently the fastest of the paddock…

anapolis Motor Speedv Results and timing service provided by TISSOT



4170 m.

RED BULL INDIANAPOLIS GRAND PRIX

After the **Race**

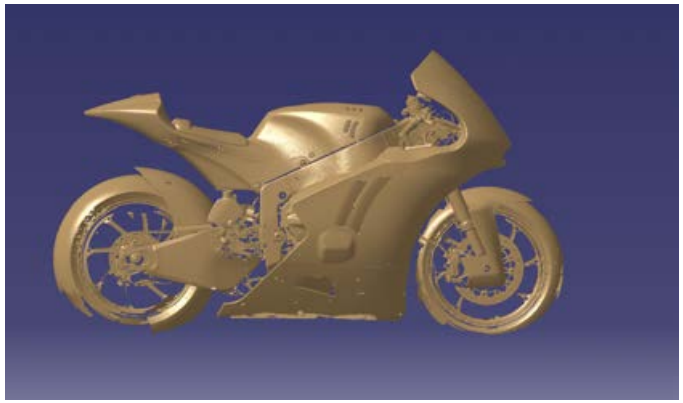
Event Best Maximum Speed

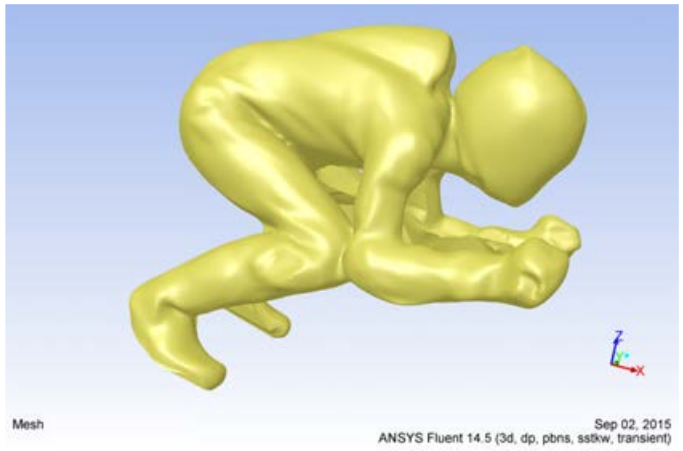
Moto2

33

	Rider	Nation	Team	Motorcycle	Km/h	
12	**Thomas LUTHI**	**SWI**	Derendinger Racing Interwetten	KALEX	**290.0**	Race
77	**Dominique AEGERTER**	**SWI**	Technomag Racing Interwetten	KALEX	**289.3**	Free Practice Nr. 1
25	**Azlan SHAH**	**MAL**	IDEMITSU Honda Team Asia	KALEX	**288.7**	Race
11	**Sandro CORTESE**	**GER**	Dynavolt Intact GP	KALEX	**287.6**	Free Practice Nr. 3
73	**Alex MARQUEZ**	**SPA**	EG 0,0 Marc VDS	KALEX	**286.9**	Race
21	**Franco MORBIDELLI**	**ITA**	Italtrans Racing Team	KALEX	**286.8**	Race
1	**Tito RABAT**	**SPA**	EG 0,0 Marc VDS	KALEX	**286.8**	Race
39	**Luis SALOM**	**SPA**	Paginas Amarillas HP 40	KALEX	**286.3**	Qualifying
40	**Alex RINS**	**SPA**	Paginas Amarillas HP 40	KALEX	**286.0**	Race
36	**Mika KALLIO**	**FIN**	Italtrans Racing Team	KALEX	**285.9**	Race
07	**Xavier VIERGE**	**SPA**	Tech 3	TECH 3	**285.9**	Race

WITH TUNNEL TESTS WITH HALF-SCALE MODEL





Scan 3D and production with 3D printers

Half-scale radiator

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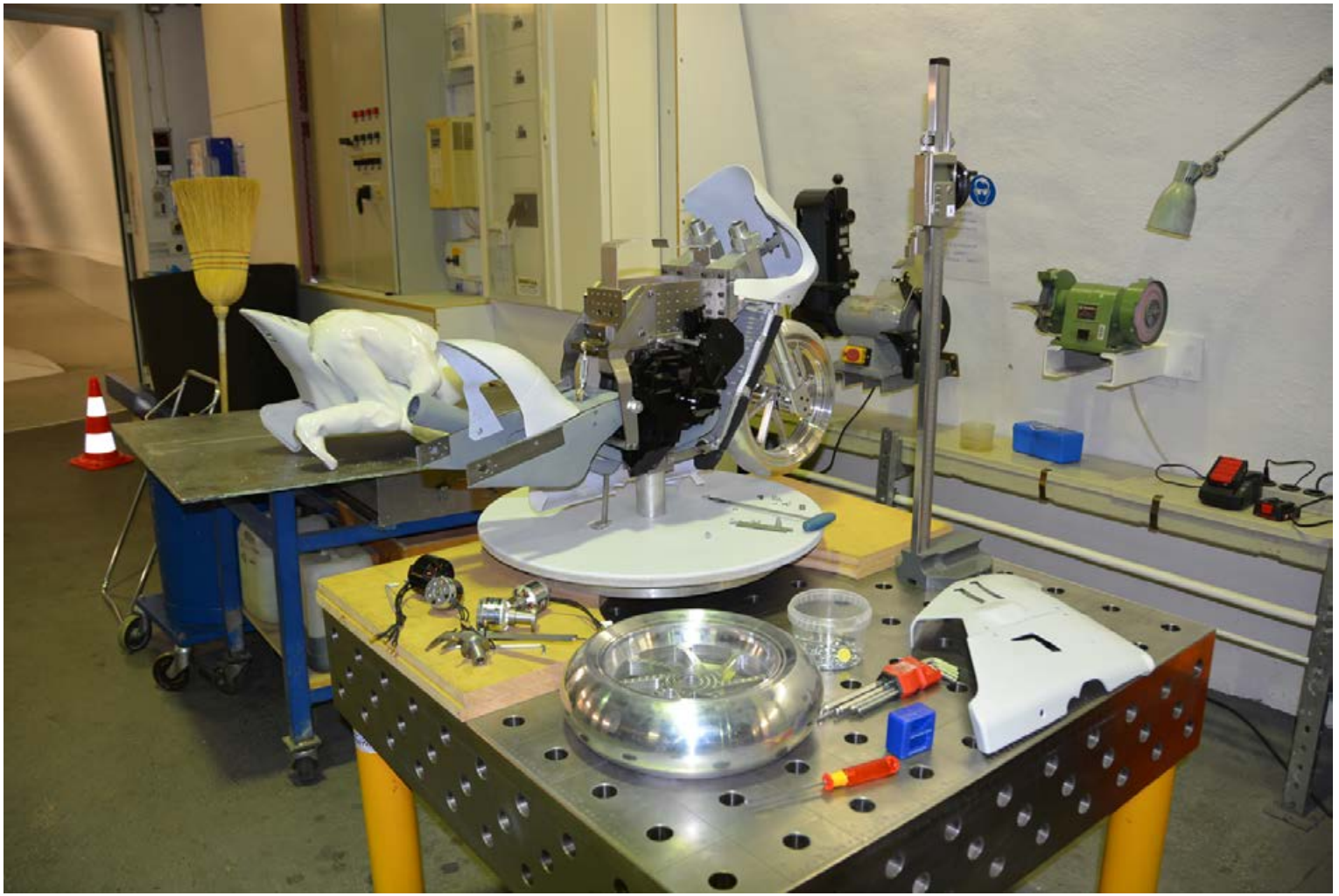
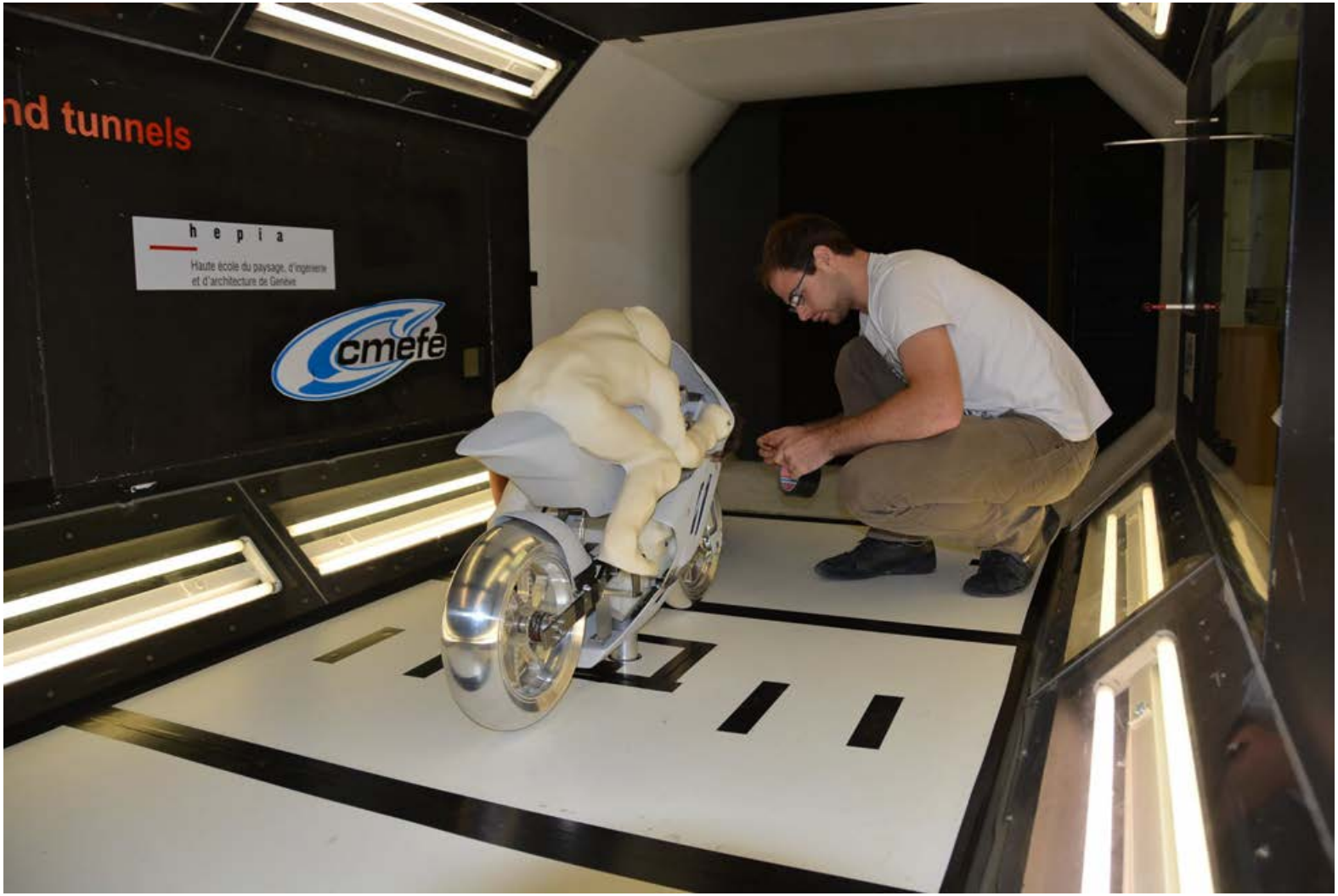
WITH TUNNEL TESTS WITH HALF-SCALE MODEL



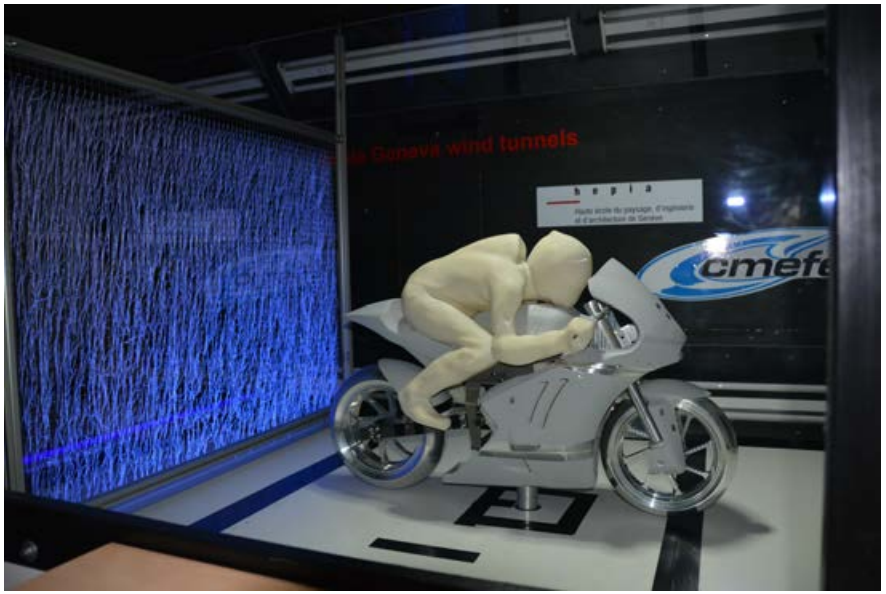
Model production

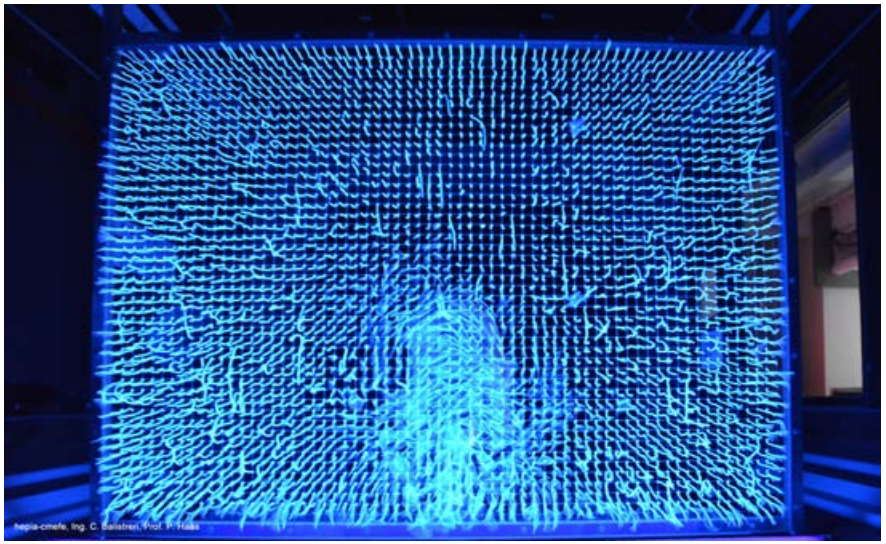
WITH TUNNEL TESTS WITH HALF-SCALE MODEL



Moto2 Kalex with Dominique Aegerter

WITH TUNNEL TESTS WITH HALF-SCALE MODEL

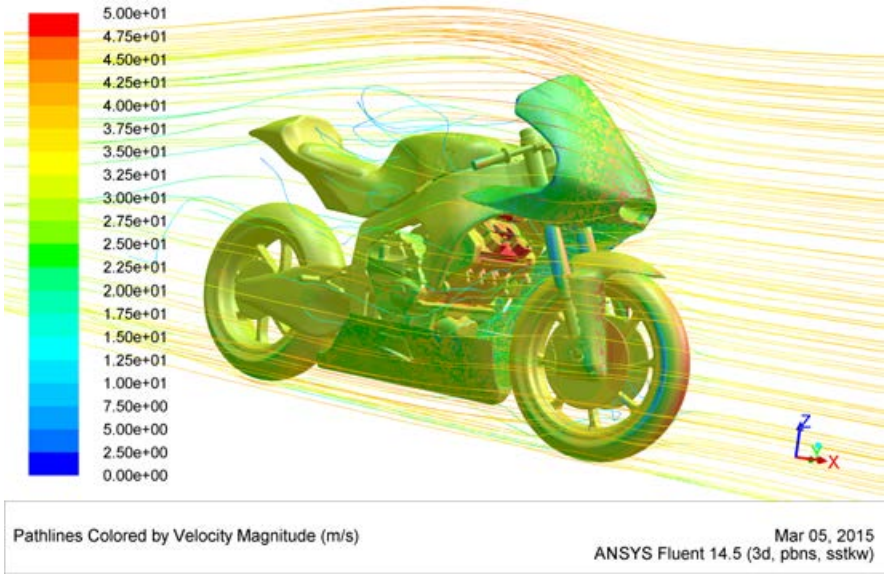




Visualization technics

Moto2 Kalex with Dominique Aegerter

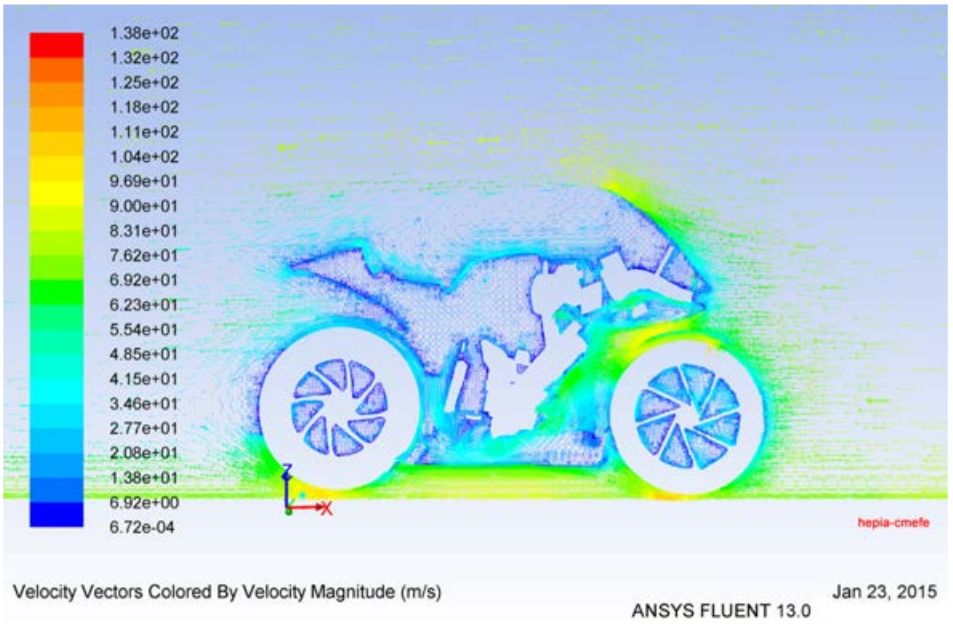
CFD SIMULATION



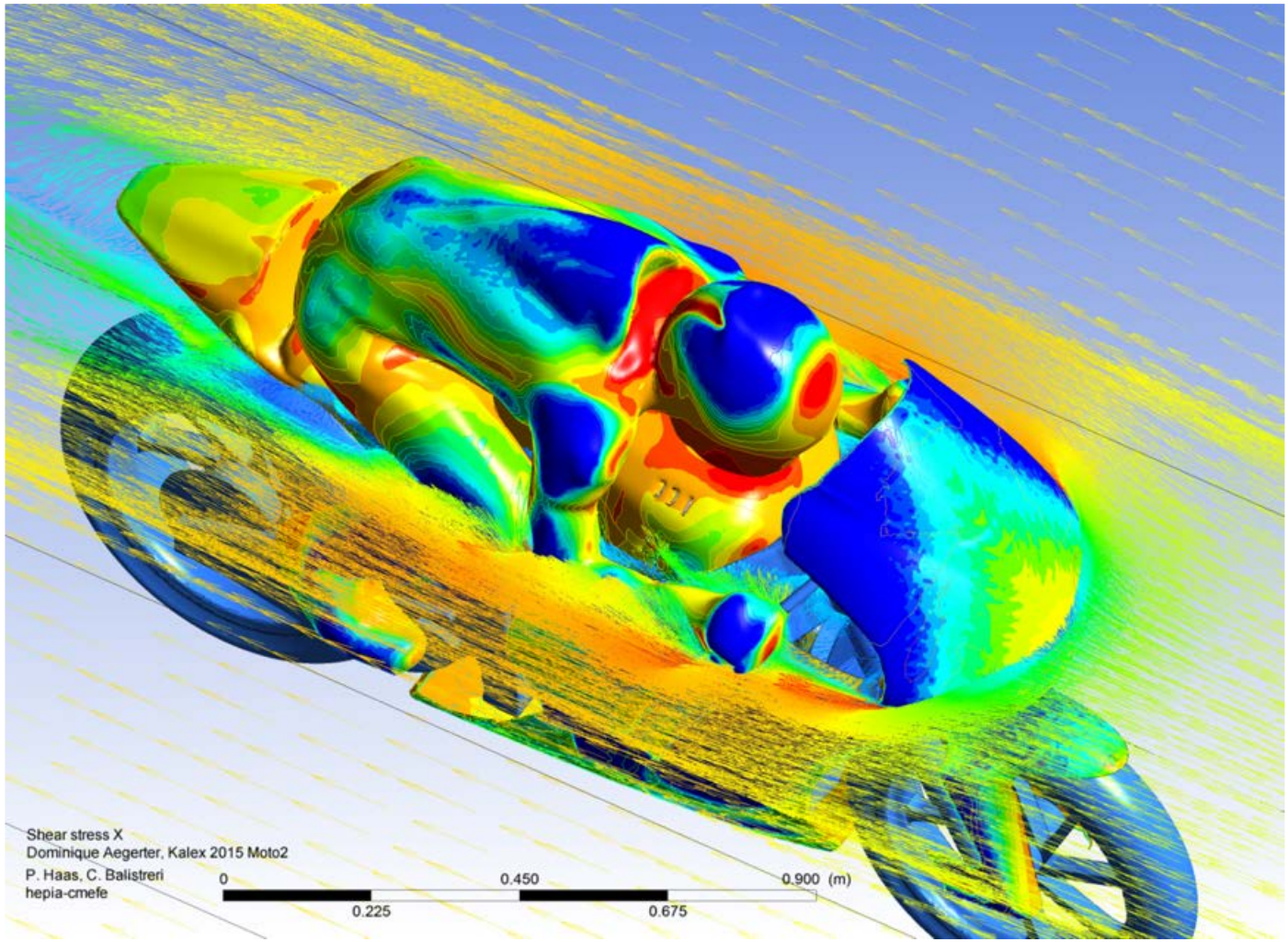
Objectives

- Internal and external aerodynamics
- Drag optimization
- Cooling and thermal evaluation

- Radiator as a model (head loss and thermal source)
- Rotating wheels

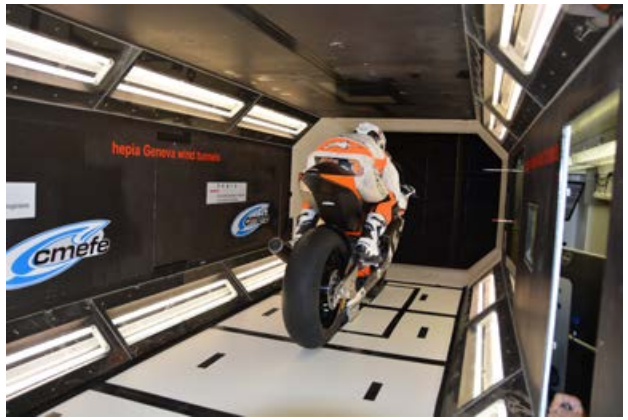


CFD SIMULATION



Moto2 Kalex with Dominique Aegerter
Shear stress x and speed in a x-y plan

THE USE OF CFD IN THE HEPIA METHODOLOGY



We have demonstrated in the Moto2 program, CFD is an important part of the methodology. At least:

- Flow understanding
- Blocage ratio correction
- Design optimization

hepia work actually using this methodology in quasi all projects performed for our industrial partners.

In a recent project, the concept has been pushed to the limit :

We performed the validation of the CFD for a case in wind tunnel at full scale and with a very large model for the test section :

- Same physics (flow, thermal, time dependent situations, ecc.)
- Approximately same gradient values
- Full details

→ Then, the final values have been calculated using the CFD model !

QUESTIONS ?

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www.cmefe.ch

hepia Geneva Wind Tunnels

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