

EMORPH
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Outline

- Research department of Peugeot Citroën SA
- Activities of our research group
- Proposed test-case
- Conclusion

Research department of Peugeot Citroën SA

- “Direction scientifique et technologies futures” (Sylvain Allano)
 - **Combustion physics** (*Erwann Samson*)
 - **Solid mechanics & materials** (*Laurent Rota*)
 - **Virtual reality & driving simulations** (*Stéphane Masfrand*)
 - **Human & social sciences** (*Patricia Jonville*)
 - **Fluid mechanics, thermal and aero-acoustics science** (*Vincent Herbert*)
 - **Mecatronics & electronics science** (*Jean-Yves Marteau*)
- ~ 100 researchers, engineers & technicians

Activities of our research group

■ Fluid mechanics, thermal and aero-acoustics science (*Vincent Herbert*)

- External Aerodynamics & Thermal management (*Fabien Harambat*)
- Aeroacoustics & Vibroacoustics (*Vincent Herbert*)
 - *Special care of the flow around front body pillar and side view mirror*
- Two-phase flow (*Marc Gohlke*)
 - *Water aspersion in the air inlet*
- Numerical fluid mechanics (*Gaëlle Servera*)

MFTA-Team : 9 researchers

3 engineers & technicians (measurements & wind-tunnel)

4 apprentices, 8 internship, 4 PhD students

■ Working with research laboratories through PhD work or participation to collaborative research works

External Aerodynamics

– *Issues of interest (Fabien Harambat)*

■ Drag reduction

■ Experiments in wind tunnel



■ Numerical simulation

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External Aerodynamics

– *research interest (Fabien Harambat)*

- Flow control over bluff-bodies :
 - Passive, active and reactive control
 - Actuators technologies evaluation

- Unsteady analysis
 - Study of links between the flow structures and their quantitative contribution to the total drag

- Study of new concepts for drag reduction

- Numerical shape optimization

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■ Body morphing

- new concept for drag reduction, interesting innovation for our research group
- In automobile, strong compromise between design and aerodynamics
- Design is essential to sell vehicle but can be opposit to the aerodynamic optimum
- Body morphing could be a way to reach the two objectives

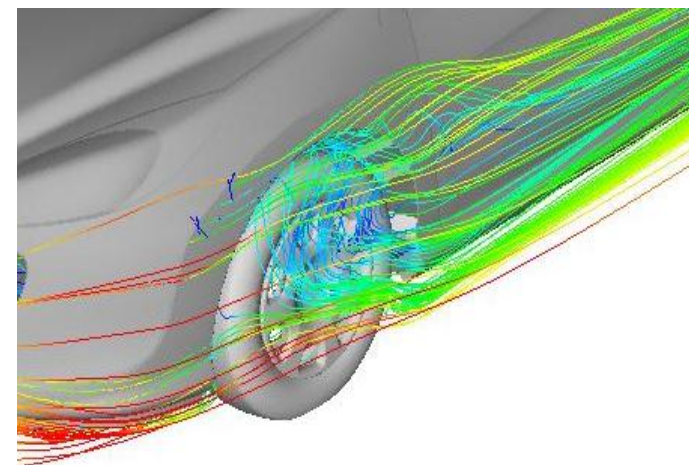
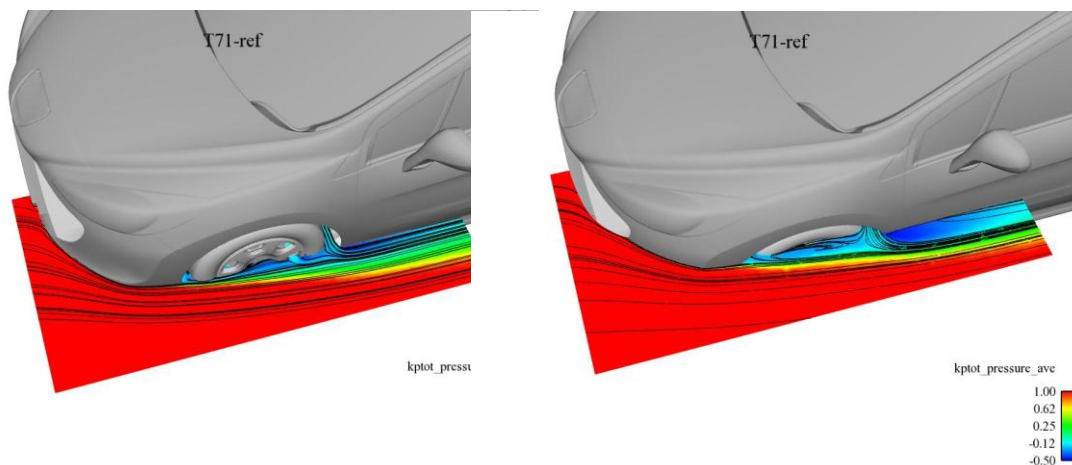
Proposed test-case

- PSA test case for ANR Emorphing
 - Flow around the front corner bumper
 - The shape of the bumper is crucial for the lateral flow on the side wall all along the vehicle
 - Strong impact on the global drag



- Example of two different shapes

- Horizontal plane



- Strong flow instabilities due to interaction between convected flow and flow inside the wheel arch

Proposed test-case

Aerodynamic optimum

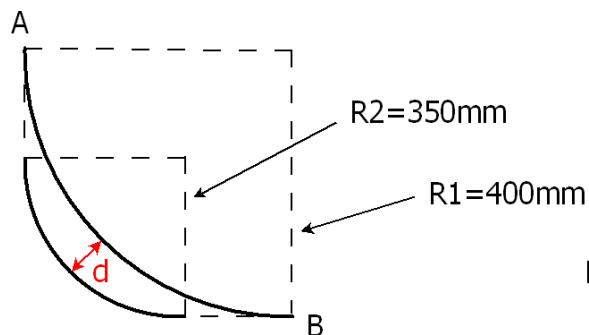
- The shape of the front corner bumper should allow a tangent flow on the side wall
- Limit recirculation or vortical structures on the side wall



Magnitude of the body deformation

Geometric parameters

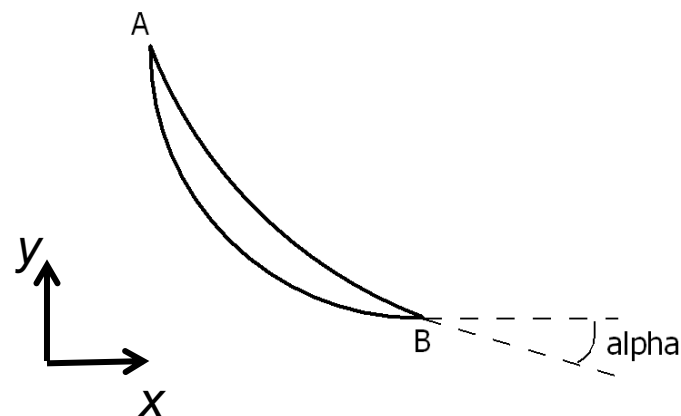
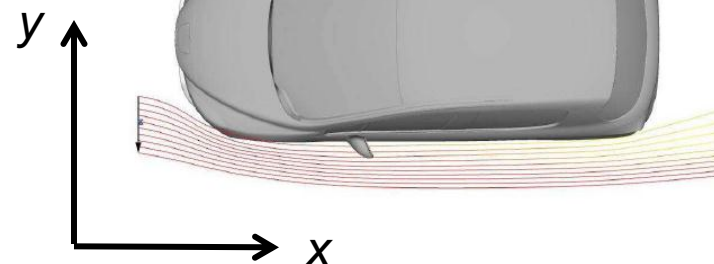
- 1 : curvature radius large enough
- 2 : incident angle of the flow on the wheel and side wall
 - Idealized situation : 0°
 - Can reach 20° on vehicles



$$L_{AB1}=628\text{mm} \rightarrow L_{AB2}=649\text{mm}$$

$$\Delta L_{AB}=21\text{mm}$$

$$d=20.7\text{mm}$$



Conclusion

- Objectives: proof of concept for drag reduction
- PSA test case
 - Morphing on the front corner bumper
 - Magnitude of the morphing : a few centimeters on an element of 60cm long
- PSA contribution:
 - Numerical simulation with different shape of front corner bumper
 - Car prototype
 - Wind-tunnel session in industrial and semi-industrial wind-tunnels
 - S2A, S4 & LFV
 - PIV, LDV, wall pressure, drag and lift, microphones

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