Mini séminaire

Le morphisme électroactif hybride :

des ailes d'avion déformables par des matériaux intelligents manipulant les turbulences.

Gurvan JODIN

2010 - 2014	MéKtro
2013	Agrég SII IE
2013 - 2014	M2 Master International Génie et Systèmes Électriques Toulouse INP - N7
2014 - 2017	Doctorat - LAPLACE et IMFT, Toulouse
2018	PostDoc - MIT, LAPLACE et IMFT, Boston
2018 - 2019	PostDoc - SATIE, ENS Rennes

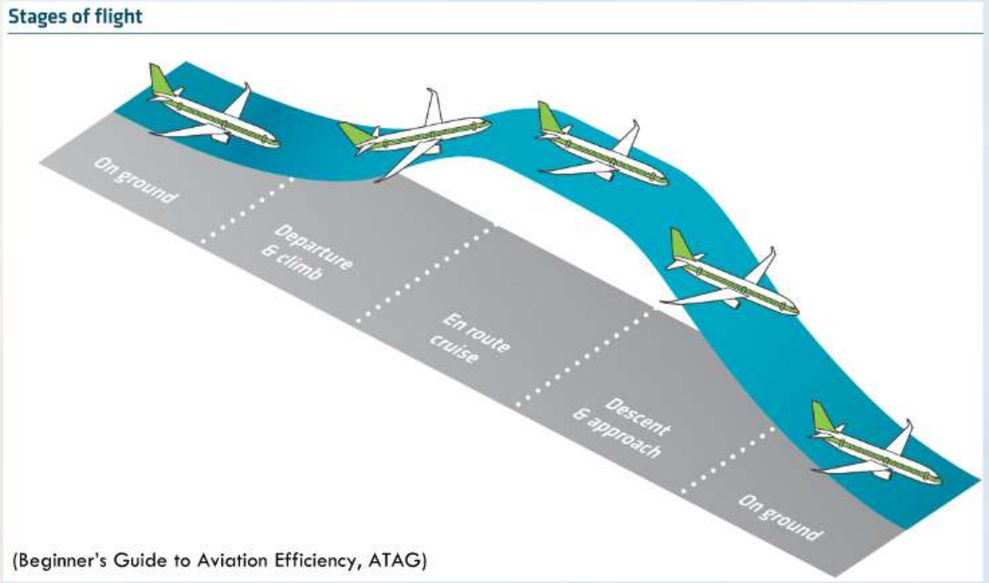
Electroactive hybrid morphing at real scale, Application to Airbus A320 wings

Thesis defended by Gurvan Jodin

Directed by prof. Jean-François Rouchon and DR Marianna Braza

Refereed by prof. Julian Hunt and prof. Lionel Petit

Examined by prof. Michael Triantafyllou, Dr. Jean-Michel Saucray, prof. Frank Thiele



Industrial concerns:

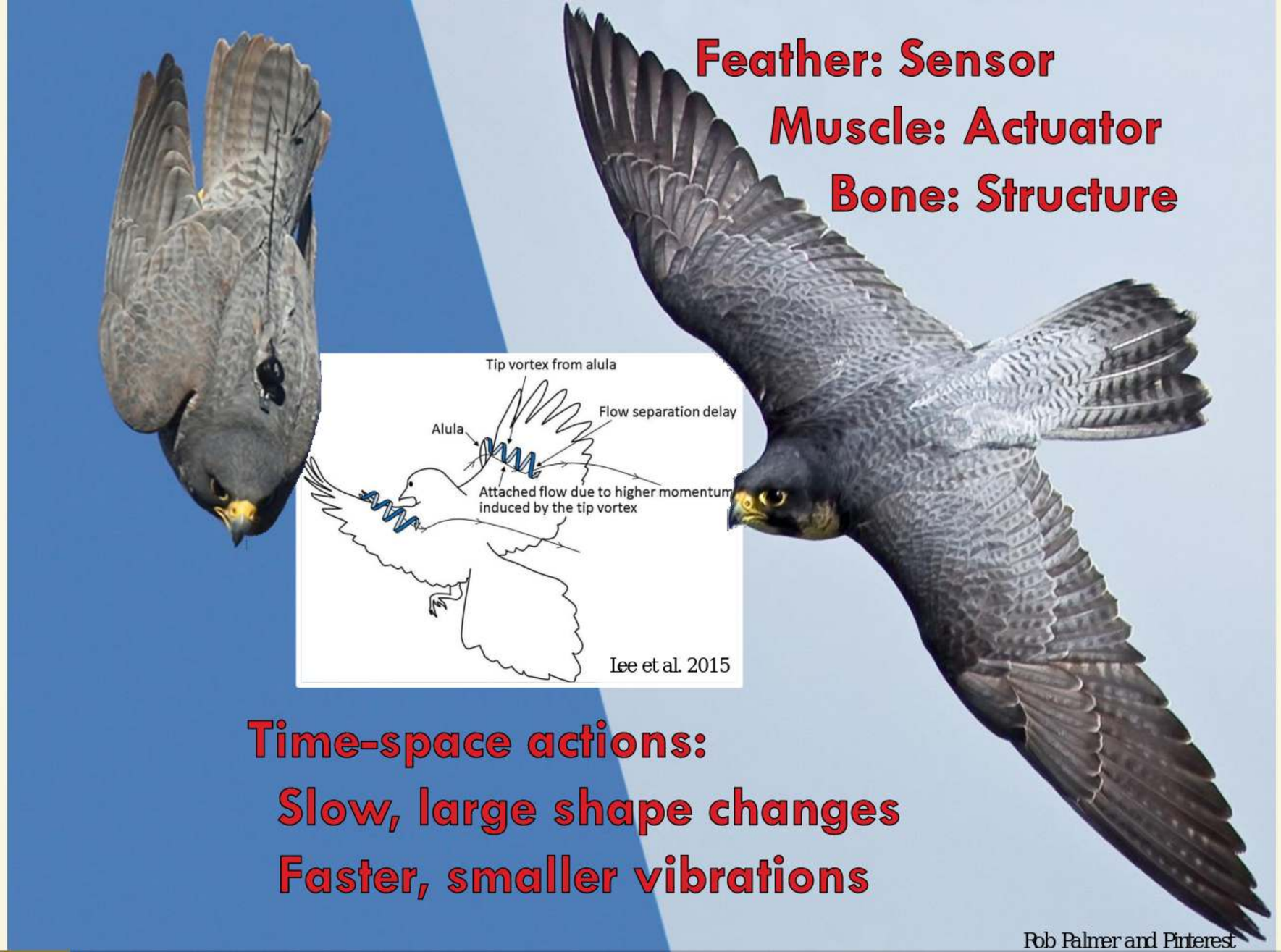
Fuel burn

Aerodynamic performance

Approach/landing

Noise

Rob Palmer and Pinterest

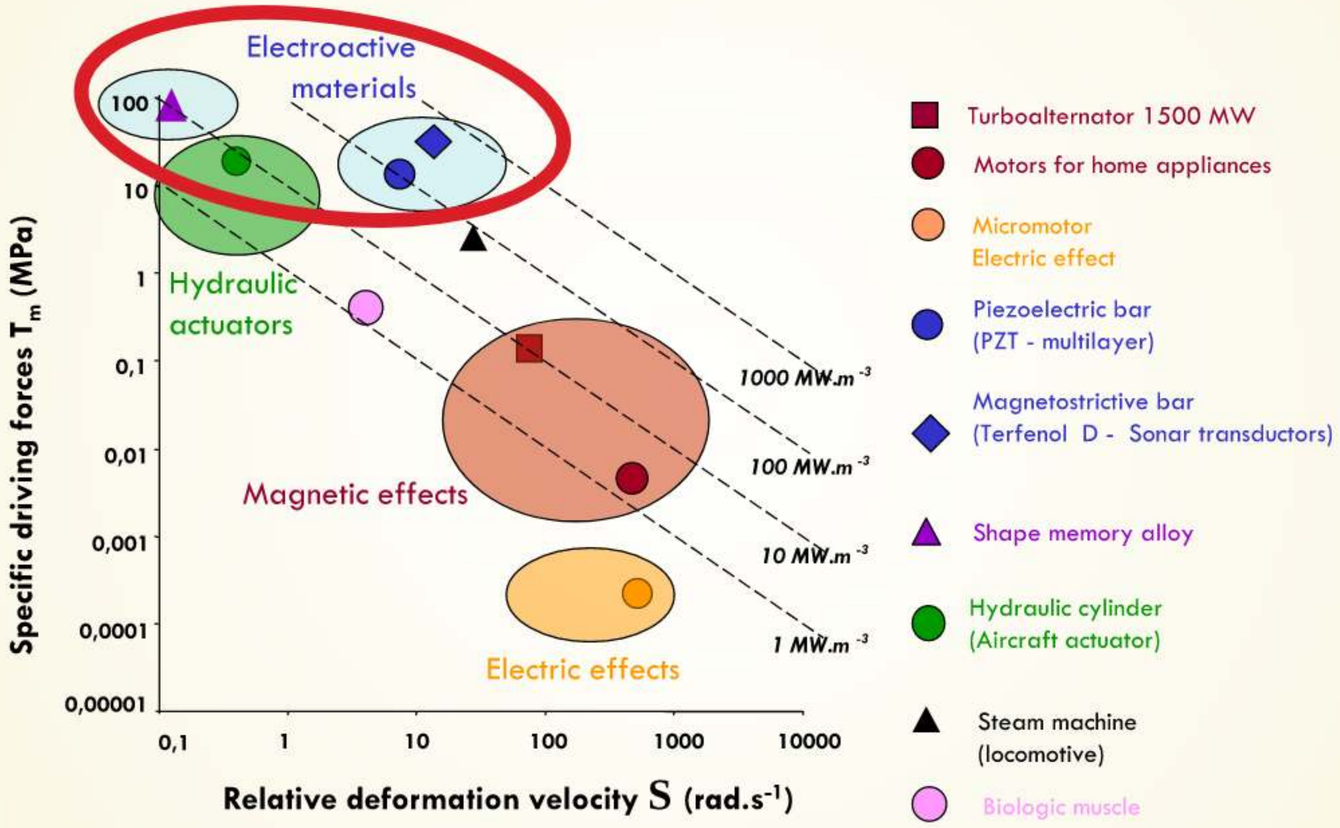

Feather: Sensor
Muscle: Actuator
Bone: Structure
Tip vortex from alula
Flow separation delay
Alula
Attached flow due to higher momentum induced by the tip vortex
Lee et al. 2015
Time-space actions:
Slow, large shape changes
Faster, smaller vibrations
Rob Palmer and Pinterest

Morphisme électroactif hybride

- Airflow around an airfoil
  - Global scale : large amplitudes at low frequencies
    - Lift, Drag, Von Karman vortices
  - Smaller scale - shear layers… : small amplitudes at higher frequencies
    - Drag, Noise, Kelvin Helmhotz vortices

Technology proposals

- Comparison of different actuating technologies



- Airflow around an airfoil
  - Global scale : large amplitudes at low frequencies
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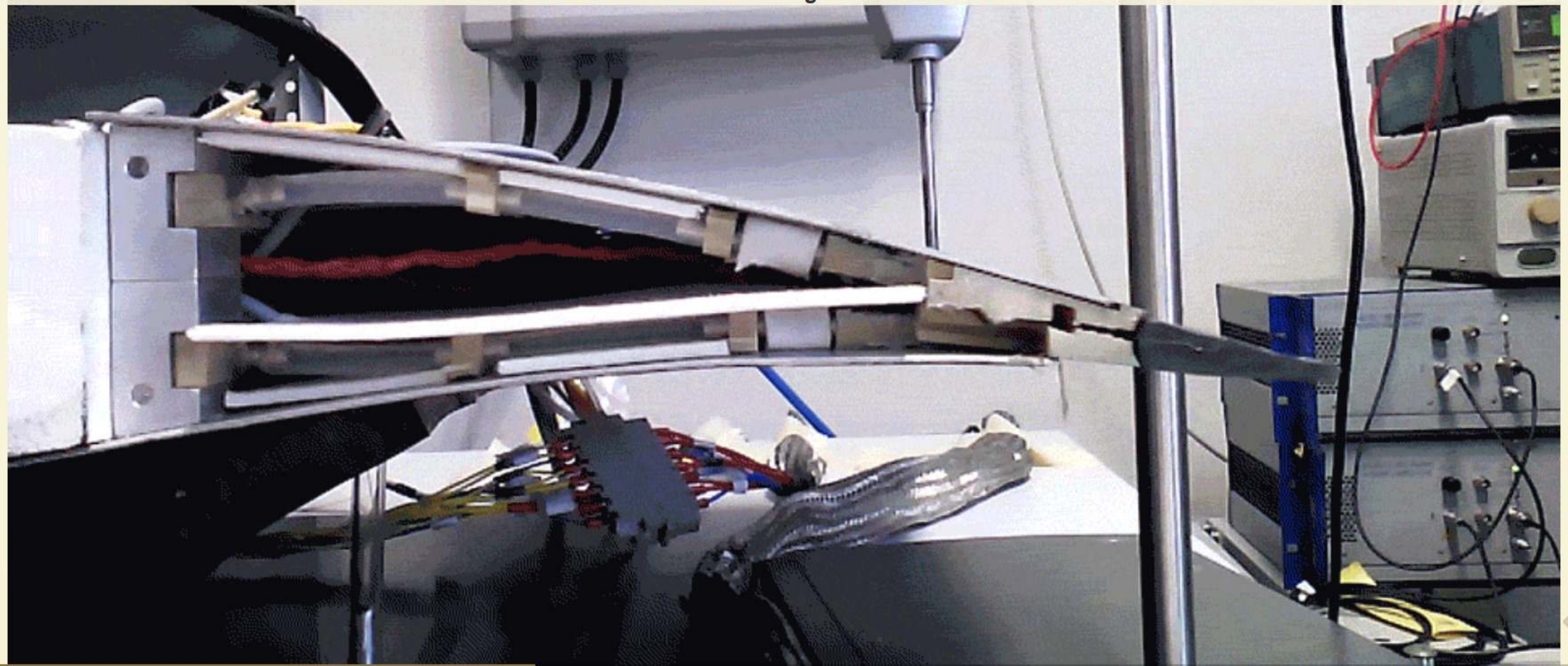
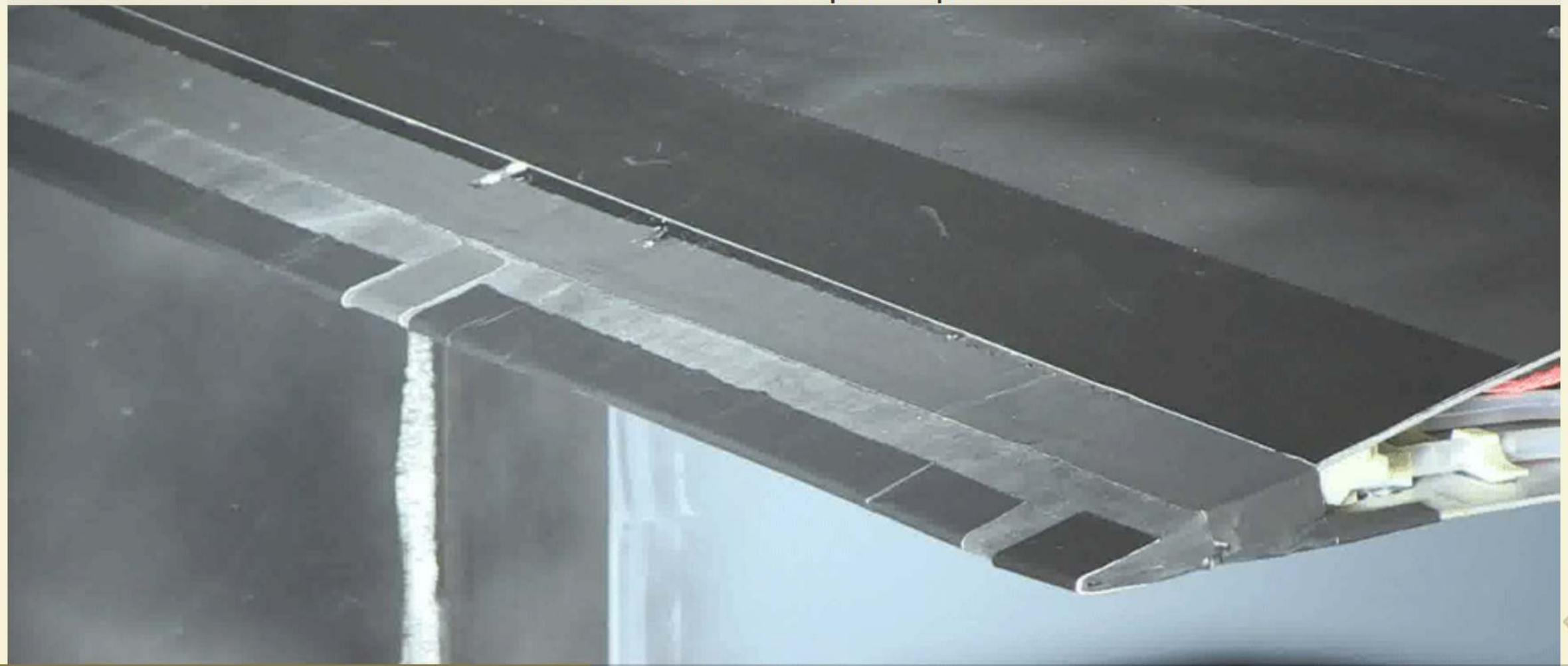
  - Smaller scale - shear layers… : small amplitudes at higher frequencies
    - Drag, Noise, Kelvin Helmhotz vortices

- Different electroactive materials
  - Shape Memory Alloys
    - Thermo-mechanical behavioural
  - Piezoelectric composite patches
    - Electro-mechanical behavioural

Contrôle de cambrure : Alliage à mémoire de forme



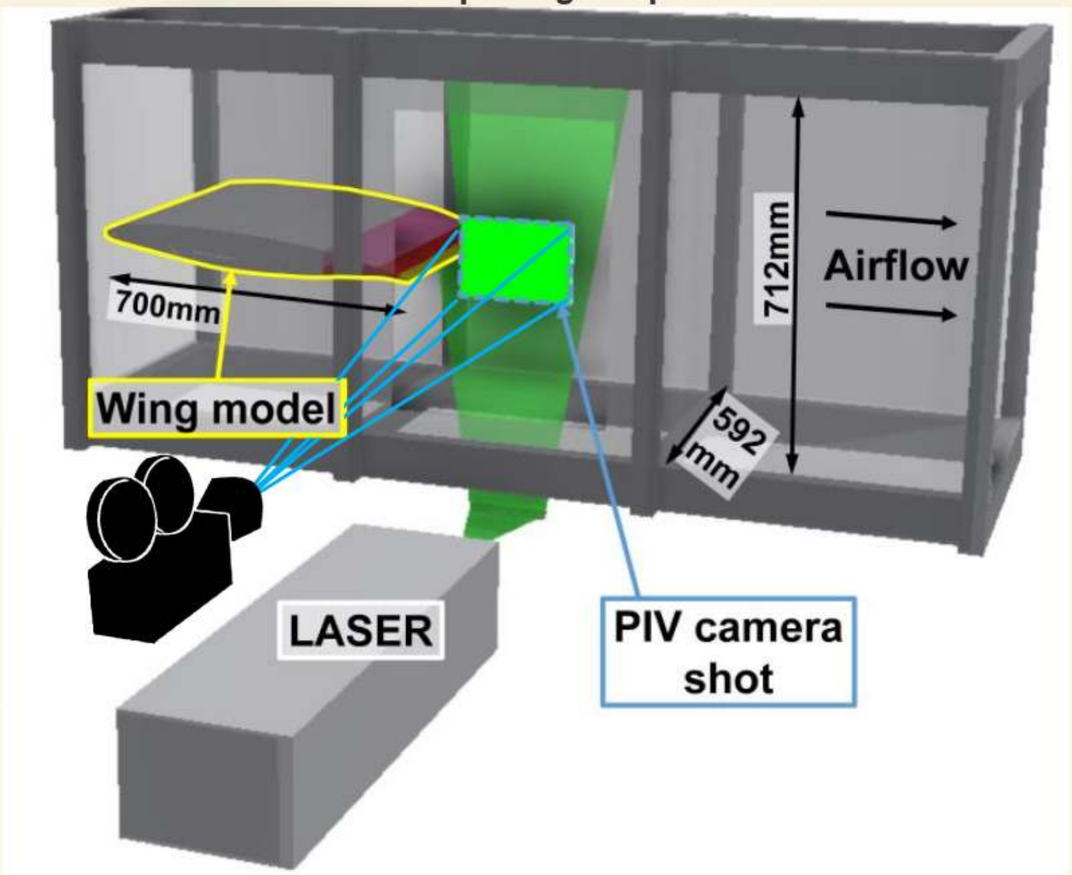
Bord de fuite vibrant : MFC piézoélectriques



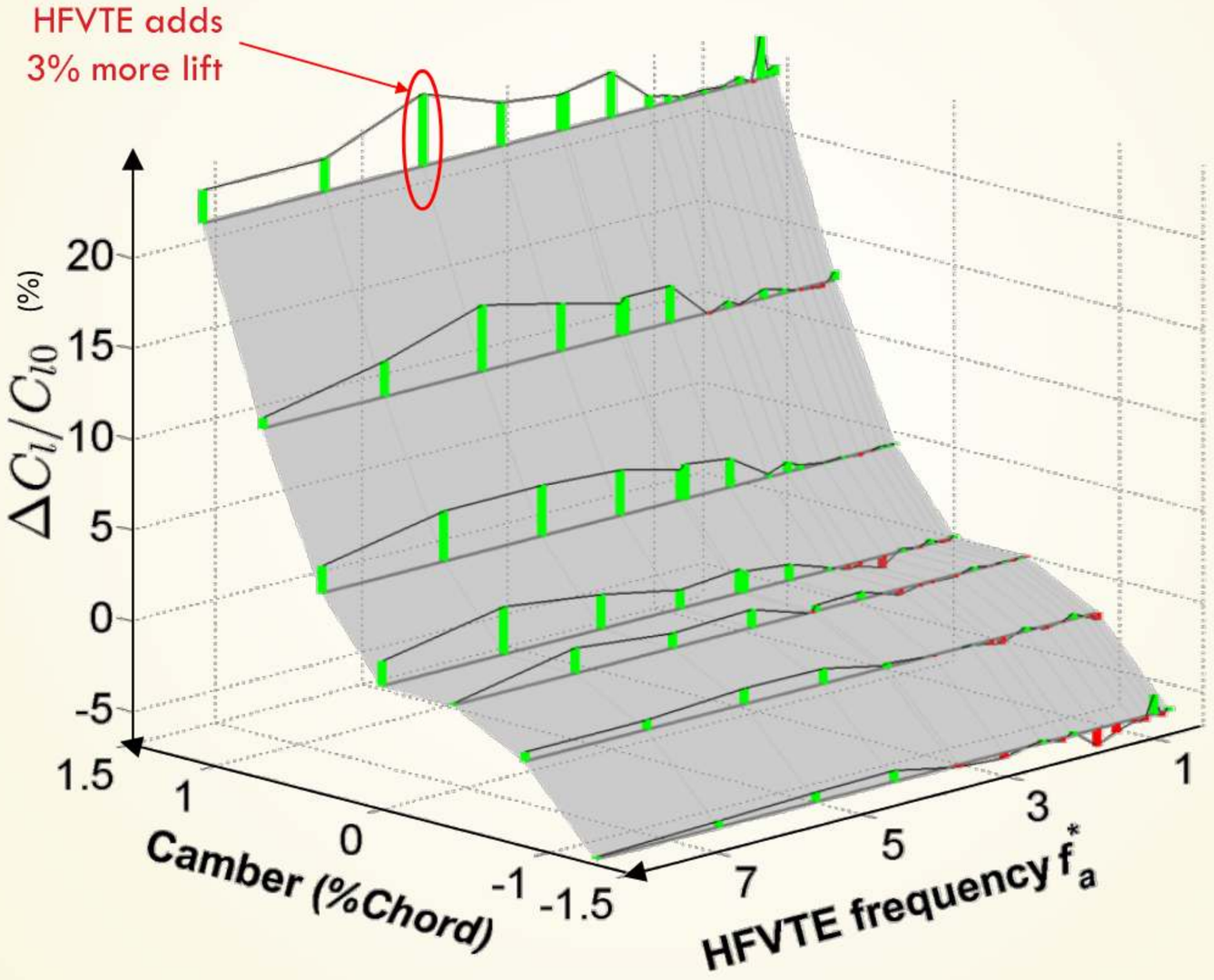
Expériences en soufflerie

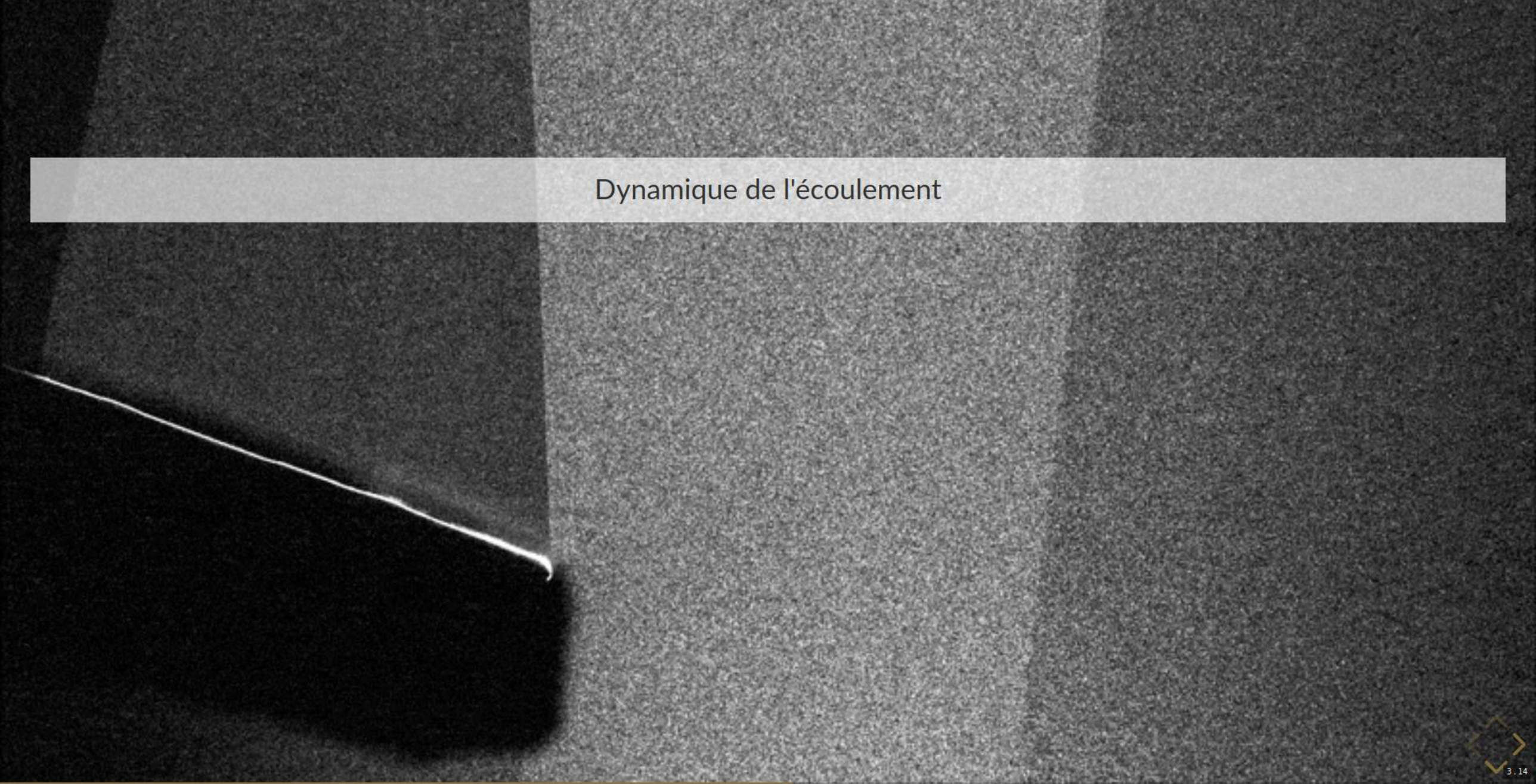
Soufflerie :

- mesures portance/trainée
- vélocimétrie par images de particules PIV



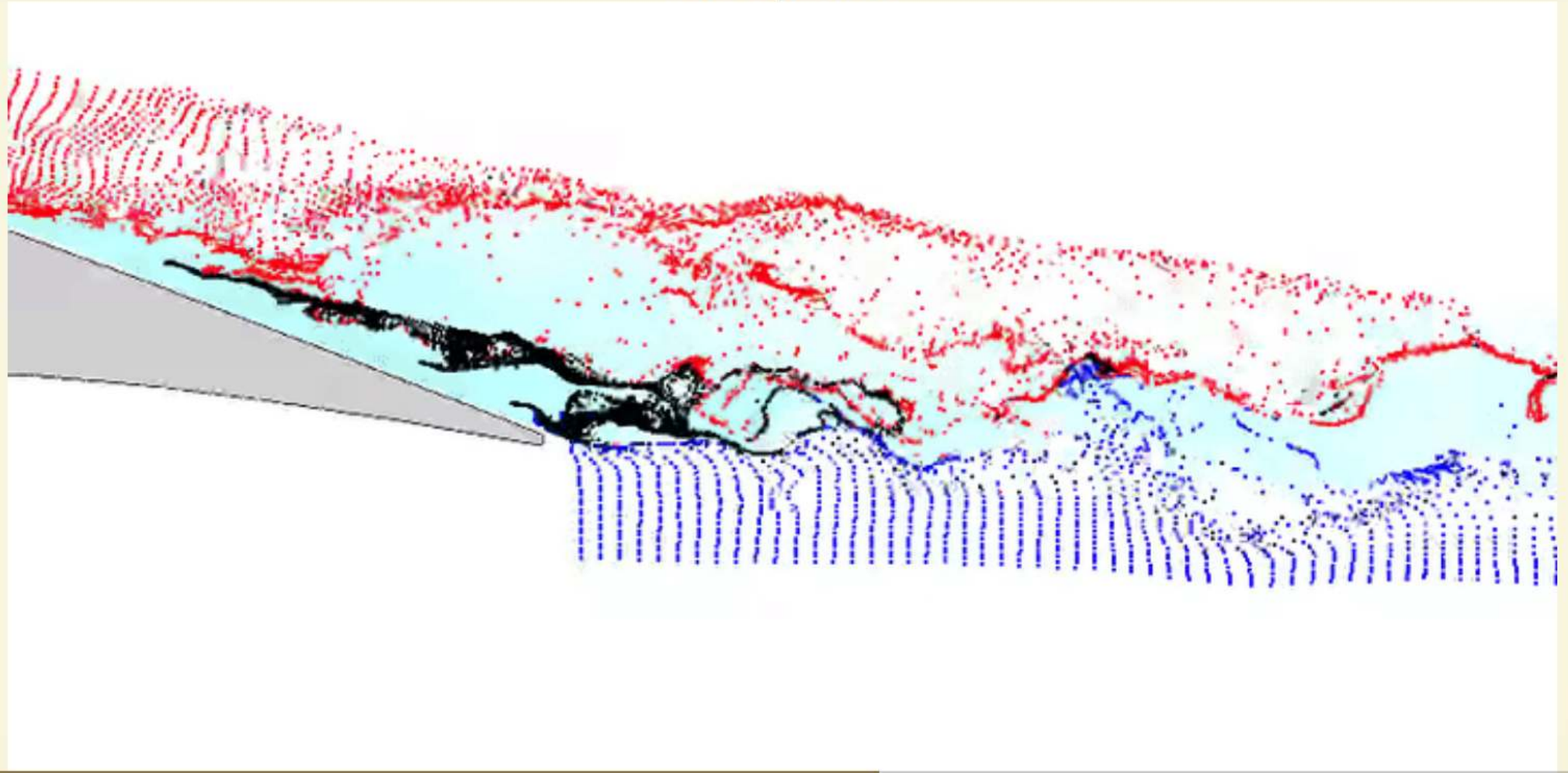
Morphisme hybride et portance



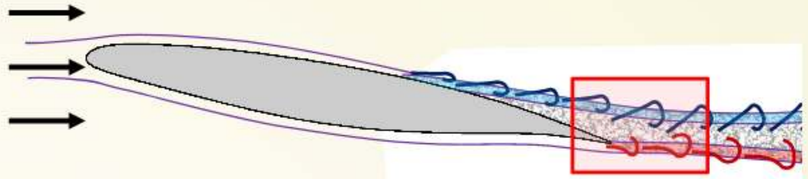


Dynamique de l'écoulement

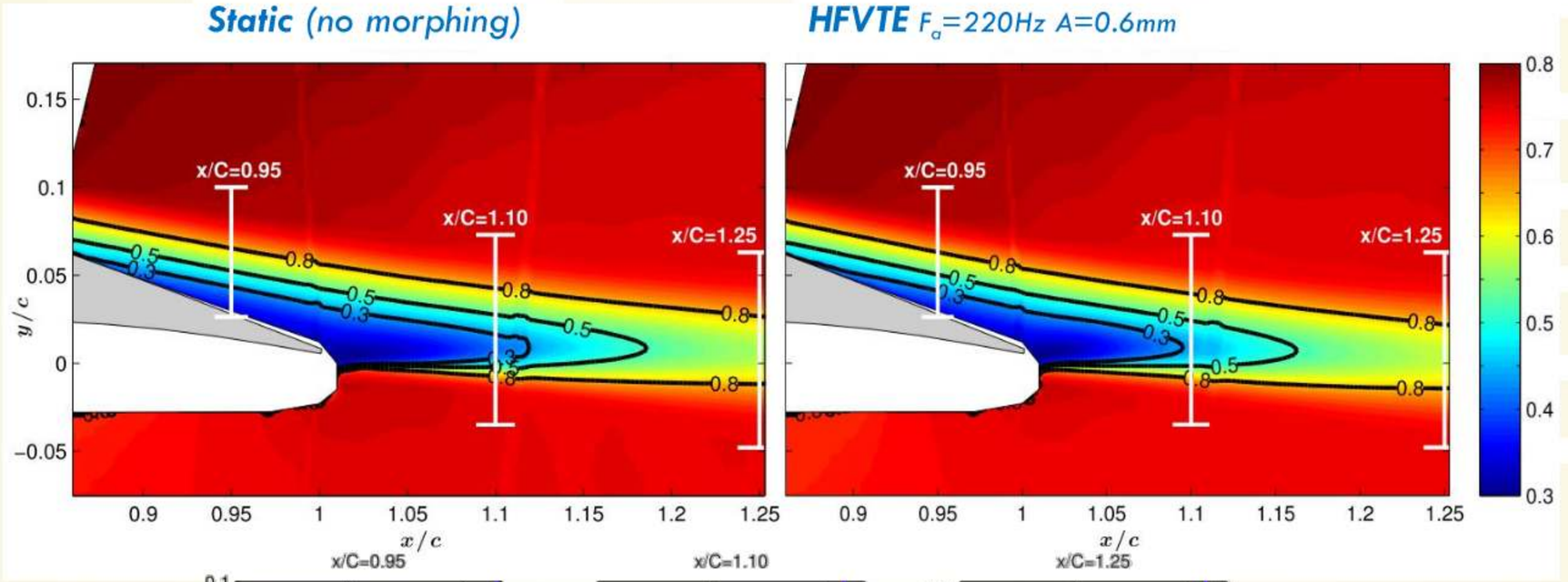
HF TR-PIV post-traitée

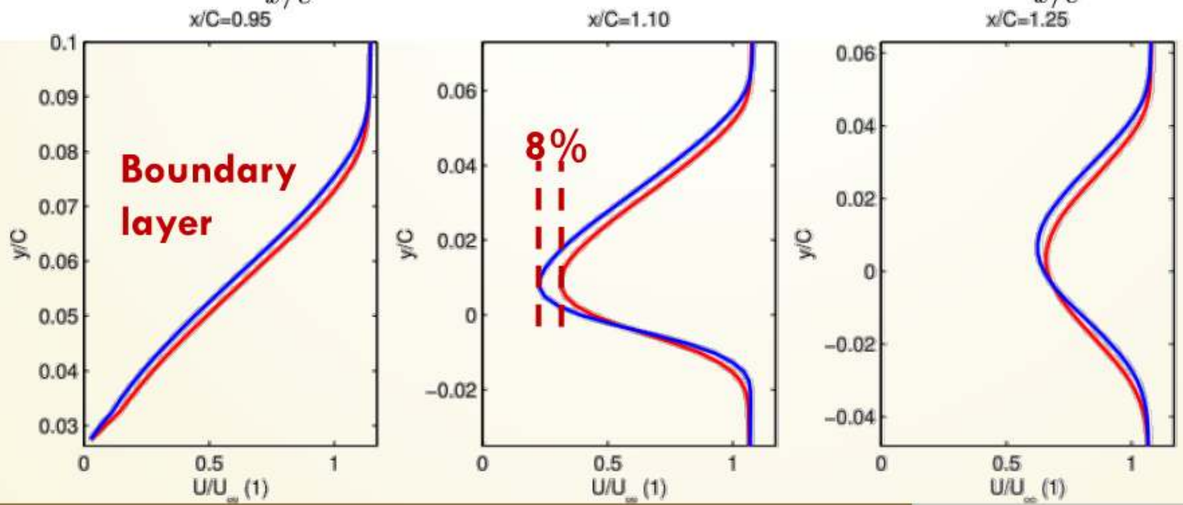


Morphing effects on airflow



- Time average fields





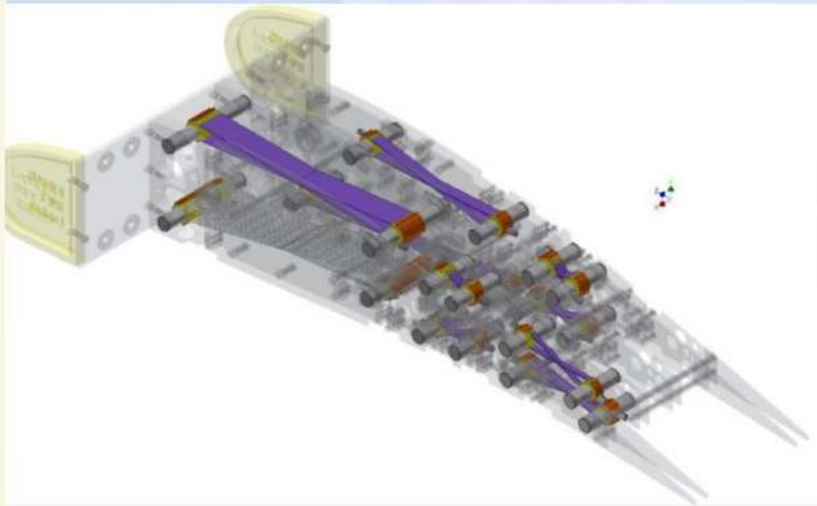
Static

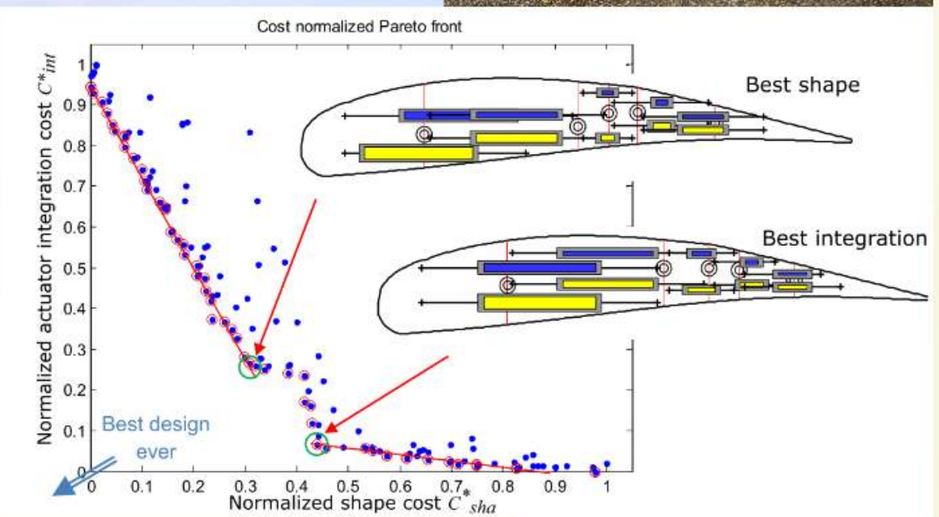
Morphing

- Maquette échelle réduite
  - modélisation actionneurs électroactifs
  - conception, fabrication, contrôle, validation
  - système mécatronique
- Expériences en soufflerie
  - grosse installation expérimentale
  - effets macroscopiques
  - explications des effets locaux
- Travail en équipe
  - 2 labos + 1 industriel

La suite ...
... est maintenant

Vers l'échelle réelle

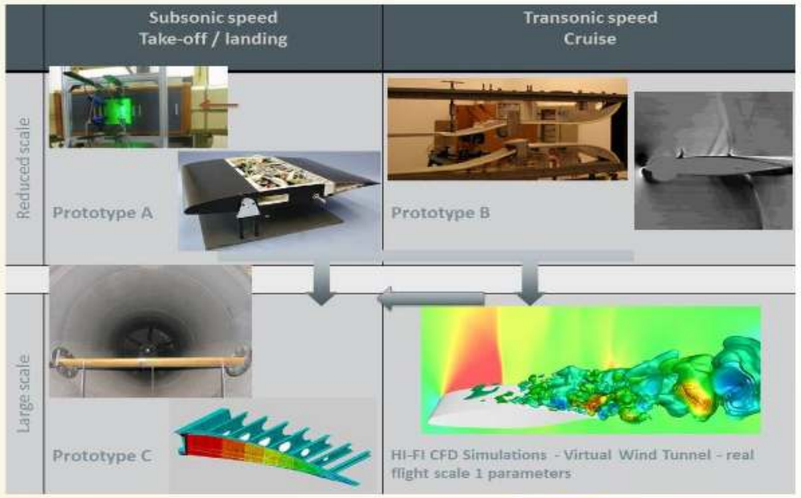




Smart Morphing and Sensing
for aeronautical configurations

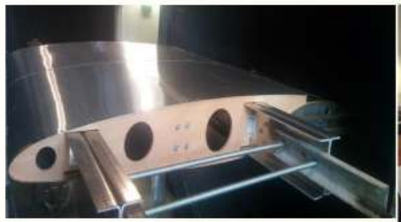
UE project – H2020
May 2017 – April 2020

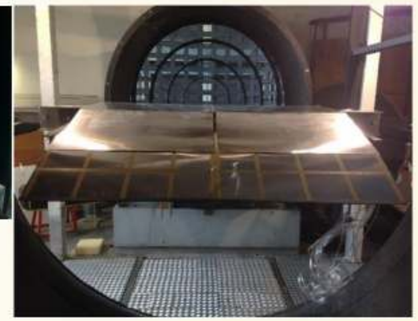
coordination INPT
No723402



Turbulence manipulation
- Understanding / Control
- Experiments / CFD-CSM simulations

Actuators for morphing
- True scale / Meta-actuators
- Resonance / New electroactive materials





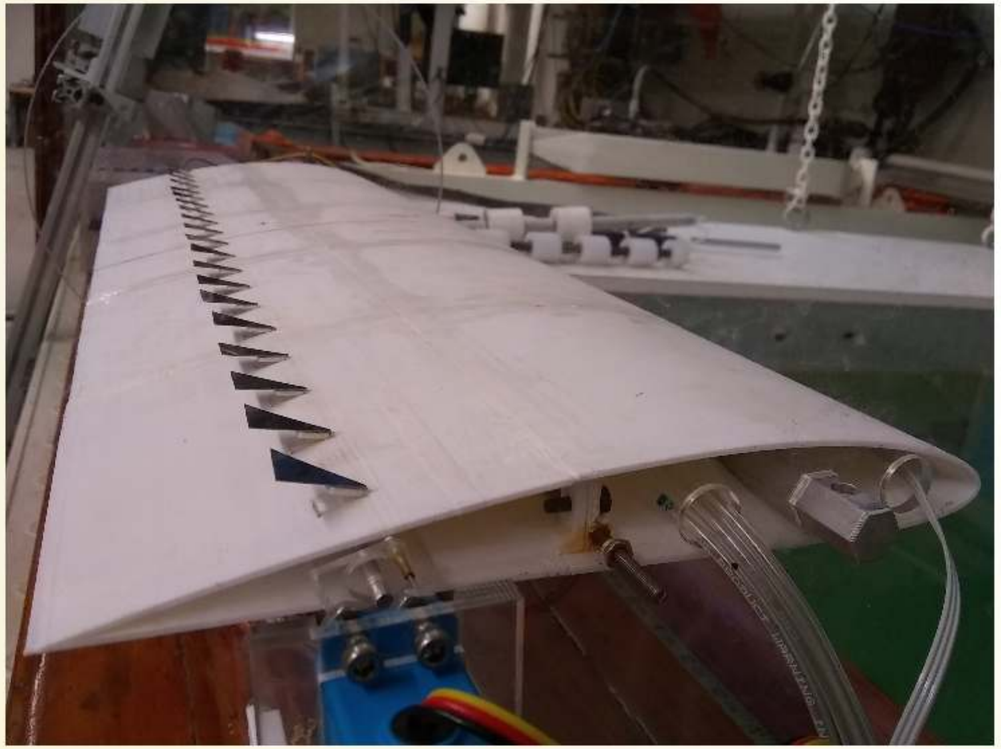
IMFT S1 wind tunnel

Real scale demonstrator
Airbus' demonstrator
SMS' experimental platform
Design and making in progress
- Camber control
- HFVTE

Merci

Massachusetts
Institute of
Technology

Hydrodynamique, contrôle de détachement par "winglets" actifs



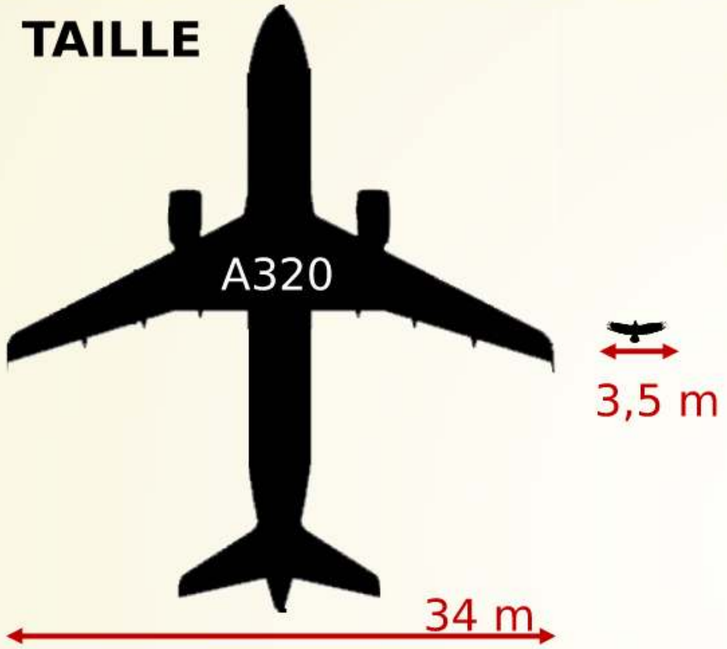
Penguin robot

Work done so far

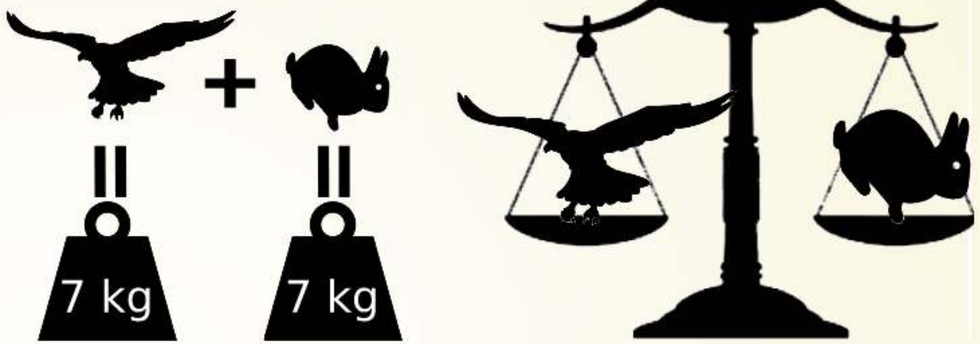
- Summer trainees
- Mechanical design

COMPARAISON OISEAUX ET AVIONS

TAILLE



CHARGE UTILE ET POIDS



VITESSE