Postdoctoral fellowship

Post-doctoral position in "Closed-loop active flow control applied to real car"

Advisor/Co-advisor: Laurent Keirsbulck, Sébastien Delprat, professors at the UPHF (LAMIH) and Quentin Gallas at LMFL

Ref : ELSAT2020- OS4 EE P2 - LAMIH/UVHC/1

Keywords: Nonlinear Control, Active flow control, Real car.

Description

Context & objectives

Many ground transport applications can be approximated by the wake of bluff bodies **[5, 6]**. This wake leads to detrimental effects such as drag increase, lift decrease and vortex induced vibrations. Despite decades of intensive research in shape optimization, aerodynamic mechanisms such as separation represent an important source of energy expenditure in transport vehicles. To improve the aerodynamic performance of vehicles, the manufacturers have developed different strategies over the years. Passive **[7]** or active **[2, 4]** flow control using active micro-blower devices **[1]** can be used to mitigate the wake effects without strong shape modifications by inducing perturbations able to interact with natural flow instabilities **[3]**.

From a control perspective, the problem is challenging since the equations of the flows can hardly be used to derive a model. A black-box modelling approach (driven by some knowledge of the underlying physics) is thus preferred. Successful preliminary experiments proved that the control problem is tractable but a suitable control framework needs to be developed. The problem is to find a compromise between the energy consumed by the actuator and the achieved drag reduction.

The objective of this research (postdoc 12 months) is to develop the control strategies further and apply them to real car in order to achieve a measurable drag reduction control. A range of experiments is available, from bluff bodies geometries (Ahmed body) in wind tunnel up to an instrumented car on test track or wind tunnel.

Candidate profile

Education: Automation and control

The candidate will have to develop real time control laws and test them on different experimental hardware. He will also be able to perform measurements and to perform advanced post-processing signal. The candidate should have a strong background in nonlinear control and should be willing to experiments these controls. Prior experience in active flow control (experiments in wind tunnels, knowledge about relevant sensors and actuators, etc.) or automotive control with dSpace systems is greatly appreciated.

Throughout the period, the candidate will also have to promote the results achieved through talks at national and international conferences as well as publications and regular technical notes.

Candidate profile:

Experience in control engineering (ideally automotive and/or flow control experiments)

Knowledge of Matlab/Simulink will be appreciated

Team worker, ability to communicate.

Applications (email only) : CV + letter describing at least (i) your skills (ii) any experience related to automotive (iii) copy of your main publications.

Fellowship: ~2200€ net

Duration : 12 months

Start date : As soon as possible

Contact: sebastien.delprat@univ-valenciennes.fr

French is NOT needed if you can speak & write English**.**

Bibliography

[1]- *Dynamic characterization of piezoelectric micro-blowers for separation flow control.* C Chovet, M Lippert, L Keirsbulck, JM Foucaut. **Sensors and Actuators A: Physical 249, 122-130, 2016**

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[2]- *Experimental study of flow control on bluff body using piezoelectric actuators.* N Tounsi, R Mestiri, L Keirsbulck, H Oualli, S Hanchi, F Aloui. **Journal of Applied Fluid Mechanics 9 (2), 827-838, 2016**

[3]- *Experimental and numerical investigations using Lattice Boltzmann Method to study shedding vortices in an unsteady confined flow around an obstacle.* A Wafik, A Fethi, L Keirsbulck, BN Sassi. **Journal of Fluids Engineering 137 (10), 101203, 2015**

[4]- *Active flow control at the rear end of a Generic car model using steady blowing.* R Mestiri, A Ahmed-Bensoltane, L Keirsbulck, F Aloui, L Labraga. **Journal of Applied Fluid Mechanics 7 (4), 565-571, 2014**

[5]- *Wall shear stress characterization of a 3D bluff-body separated flow.* G Fourrié, L Keirsbulck, L Labraga. **Journal of Fluids and Structures 42, 55-69, 2013**

[6]-Volumetric 3-component velocimetry measurements of the flow field on the rear window of a generic car model. N Tounsi, G Fourrié, H Oualli, L Keirsbulck, S Hanchi, L Labraga. **Thermal Science 16 (1),** 313-320, **2012**

[7]- *Bluff-body drag reduction using a deflector.* G Fourrié, L Keirsbulck, L Labraga, P Gilliéron. **Experiments in Fluids 50 (2), 385-395, 2011**

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