Post-Doc position

Research of a new strategy for the control of separation

Subject: In transportation, the highest energy losses are aerodynamic when speeds above 50 km/h are reached. Shape optimization techniques have now reached their limit and can only bring small improvements at the cost of considerable experimental and/or computational cost. In this context, reactive flow control strategies can provide the technological breakthrough needed to achieve the 25% drag reduction target set at the horizon 2020. Such work must be sustainable in order to rise the challenges associated with energy expenditure, in particular in support of the project "2l / 100" carried by the PFA in the context of the program Future Vehicle Investments Future (PIA) operated by ADEME.

In the aeronautical field too, flow control has become an issue for the improvement of lift and the release of certain wing stresses. These improvements will directly result in a reduction of nuisances (polluting emissions or even noise), consumption and improved safety in flight. Other areas could be impacted by effective control technologies, for example the field of wind turbines, turbomachinery or naval.

For more than ten years, researchers have succeeded in delaying the separation by completely reorganizing the turbulence upstream of the separation to restore the momentum of the fluid at the cost of a significant energy expenditure. The work carried out on massive detachments has therefore shown the limitation of these methods in terms of energy balance. The work proposed here is to rely more on the incident flow by trying to manipulate the structures most responsible of the separation as soon as possible to reduce the intensity of the separation and thus gain a little on the aerodynamic balance keeping priority to the efficient control. For this study, the candidate will have at his disposal the LMFL high Reynolds number boundary layer wind tunnel equipped with the AVERT model for flow control studies [1,2]. He will also dispose of the optical metrology know-how of the team as well as the related equipment to carry out this project.

The laboratory: Laboratoire de Mécanique des Fluides de Lille – Kampé de Fériet is a joint laboratory between: Centrale Lille, Université de Lille, Ecole Nationale des Arts et Métiers, ONERA and CNRS, where 35 faculties and engineers work in the fields of Aerodynamics.
The team hosting the Post-Doc is involved in fundamental study of turbulence, and optical measurement techniques. This team has already developed and characterized classical and stereoscopic PIV (http://www.meol.cnrs.fr/) and has participated to several European projects and networks on these topics.

The subject: In the frame of the CONTRATECH project of ELSAT2020, the idea of this post doc is, first of all, to improve the understanding of the interaction between the large-scale structures developing in the outer zone of the boundary layer and the separation of the flow, and in a second time, to detect particular events at the wall indicating the presence of large-scale structures. A new control strategy based on the manipulation of large-scale structures to delay separation can be proposed and implemented to improve the balance of aerodynamic forces on the object (e.g. decrease of the drag).

The fellowship: The amount is 2200 Euros per month and the employer is Central Lille.
Starting date & duration: until July 2018, 12 months (with a high probability of extension)

The candidate: Highly motivated by research in Fluid Dynamics, he has a good background in mathematics and experimental fluid mechanics. An experience in PIV will be appreciated. The candidate writes and speaks English fluently.

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References:

[1] Cuvier, C., Foucaut, J.-M., Braud, C. and Stanislas, M. (2014). Characterisation of a high Reynolds number boundary layer subject to pressure gradient and separation. Journal of Turbulence, Vol. 15, No. 8, 473–515.

[2] C. Cuvier, S. Srinath, M. Stanislas, J.-M. Foucaut, J.-P. Laval, C. J. Kähler, R. Hain, S. Scharnowski, A. Schröder, R. Geisler, J. Agocs, A. Röse, C. Willert, J. Klinner, O. Amili, C. Atkinson, J. Soria (2017). Extensive characterization of a high Reynolds number decelerating boundary layer using advanced optical metrology. Journal of Turbulence, Vol 18, No 10.