www.onera.fr

ONERA
THE FRENCH AEROSPACE LAB

PROPOSITION DE STAGE EN COURS D'ETUDES

Référence : **MAS-2022-19**
(à rappeler dans toute correspondance)

Lieu : Meudon/Chatillon

Département/Dir./Serv. : DAAA-MAPE/MSAE

Tél. : 0146235197

Responsable(s) du stage : olivier.marquet / johnn.moulin@onera.fr, nicolo.fabbiane@onera.fr

Email. : olivier.marquet@onera.fr

DESCRIPTION DU STAGE

Thématique(s) : Aeroelasticite

Type de stage : ☒ Fin d'études bac+5 ☒ Master 2 ☐ Bac+2 à bac+4 ☐ Autres

Intitulé : Delaying laminar-turbulent transition with compliant walls

Sujet : This project focuses on the use of compliant walls to reduce the frictional drag of flying machines, either by delaying the transition to turbulence in laminar boundary layers, or by acting on the large-scale structures responsible for turbulent friction. Recent works [1,2] have allowed to develop a theoretical framework (resolvent analysis) allowing the study of fluid-structure instabilities in a purely linear framework. They have been used to explain the attenuation of Tollmien-Schlichting waves, one of the aerodynamic instabilities explaining the transition to turbulence. This passive technique of laminar friction reduction is effective when the density of the material composing the elastic wall is close to the density of the fluid, which is then water. Very few studies have focused on the use of deformable walls for laminar or turbulent air flow. The first objective of the internship will be to determine and specify the type of materials that can be used for this passive friction reduction technique for an air flow. The second objective will be to use and extend the existing tools to control other aerodynamic instabilities (such as Klebanov modes in a boundary layer). To that aim, the successfull candidate will extend existing numerical tools based on the FEniCSx computing platform [3]. In particular, he will consider (i) more complex viscoelastic models of the compliant wall (from a Kelvin-Voigt model to generalised Maxwell one) as well as (ii) three-dimensional perturbations of the solid and fluid phase. After validating this numerical tool, he will use it to investigate the passive control of three-dimensional steady (Klebanov) modes by realistic elastomer elements inserted in a (otherwise) ridig wall.

This internship is funded by the Institute of Aeronautics and Astronautics, Paris-Saclay University (PSIA2).

[1] Pfister, J.-L., "Instabilities and optimization of elastic structures interacting with laminar flows", Doctoral thesis, Paris-Saclay University, Ecole Polytechnique, 2019.

[2] Pfister, J.L., Fabbiane N., Marquet O., "Attenuation of Tollmien-Schlichting instabilities with compliant walls: global stability and resolvent analysis", accepted for J. Fluid Mech., 2022.

[3] https://fenicsproject.org/.

Est-il possible d'envisager un travail en binôme ? **Non**

Méthodes à mettre en oeuvre :

☒ Recherche théorique ☐ Travail de synthèse

☐ Recherche appliquée ☐ Travail de documentation

☐ Recherche expérimentale ☐ Participation à une réalisation

Possibilité de prolongation en thèse : **Non**

Durée du stage : Minimum : 4 Maximum : 6

Période souhaitée : June-December ou September-December

PROFIL DU STAGIAIRE

Connaissances et niveau requis :	Ecoles ou établissements souhaités :
Fluid Mechanics - Fluid-structure interaction - Instabilities	Master 2 - Engineering School