

PROPOSITION DE STAGE EN COURS D'ETUDES

Référence : **DAAA-2022-023**

(à rappeler dans toute correspondance)

Lieu : Meudon

Département/Dir./Serv. : DAAA/AMES

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Responsable(s) du stage : Marie Couliou

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DESCRIPTION DU STAGE

Thématique(s) : Fluids mechanics

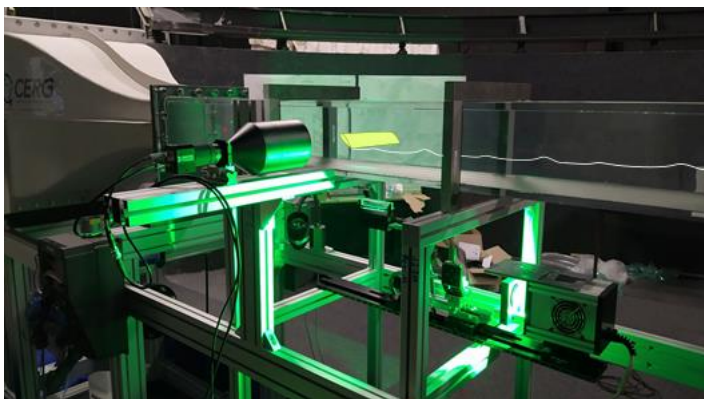
Type de stage : x Fin d'études bac+5 x Master 2 Bac+2 à bac+4 Autres

Intitulé : Experimental study of vortex meandering with effect of freestream turbulence intensity

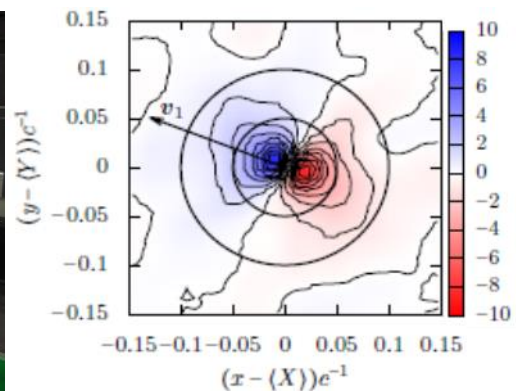
Sujet :

Wing-tip vortices generated by a finite wing continue to be of particular interest in aeronautical applications due to their significant contribution to the overall drag of an aircraft [1], and to their persistence in runways which poses a potential hazard and a flight safety concern in airports.

Over the past few decades, considerable theoretical [2] and experiment [3] efforts have been devoted at ONERA to understanding the structure and development of wing-tip vortices in the near, intermediate and far fields. In this internship, we will focus on the meandering, a manifestation of vortex unsteadiness observed in experiments since the 1970s which remains puzzling in essential aspects. Recent studies [4] suggest that mechanisms of instability and transient growth might be responsible for this meandering. The internship aims to experimentally study the meandering and questioning the effect of the freestream turbulence on it [5].



(a)



(b)

Figure 1 : (a) Hydrodynamic channel at ONERA Meudon (b) Leading POD modes of a wing tip vortex calculated from PIV velocity data [6]

The experiment will be conducted in a closed-circuit, low-speed water channel located at ONERA Meudon (figure 1.(a)). The model used in this study is a half-wing with a NACA 0012 airfoil section on which one can play on the incidence. The intern will first explore the behavior of a wing-tip vortex using the stereoscopic PIV (SPIV) measurements. Through decomposition of the SPIV data and a POD analysis ([6,7], figure1.(b)), the various physics involved will be identified. In parallel, the student will choose the design of grids to generate several freestream conditions by tuning the turbulence intensity called Tu. In a second time, the effects of these conditions will be studied using the same experiment's methods as in the reference case.

References:

[1] Spalart, P. R. Airplane trailing vortices. ARFM 1998, vol. 30, no 1

[2] Brion, V., Sipp, D., & Jacquin, L. (2007). Optimal amplification of the Crow instability. PoF, 19(11),

[3] Cruz Marquez, R., Monnier, J. C., Tanguy, G., Couliou, M., Brion, V., Cattafesta, L., & Dupont, P. (2021). An experimental study of a trailing vortex alleviation using an undulated trailing edge. In AIAA AVIATION 2021 FORUM

[4] Navrose, Brion, V., & Jacquin, L. (2019). Transient growth in the near wake region of the flow past a finite span wing. JFM, 866

[5] Bölle, T., Brion, V., Robinet, J. C., Sipp, D., & Jacquin, L. (2021). On the linear receptivity of trailing vortices. JFM, 908.

[6] Bölle, T. (2021). Treatise on the Meandering of Vortices (Doctoral dissertation, IPP)

[7] Dghim, M., Ferchichi, M., & Fellouah, H. (2020). On the effect of active flow control on the meandering of a wing-tip vortex. JFM, 896

Est-il possible d'envisager un travail en binôme ? **No**

Méthodes à mettre en oeuvre :

- | | |
|---|--|
| <input type="checkbox"/> Recherche théorique | <input type="checkbox"/> Travail de synthèse |
| <input type="checkbox"/> Recherche appliquée | <input type="checkbox"/> Travail de documentation |
| <input checked="" type="checkbox"/> Recherche expérimentale | <input type="checkbox"/> Participation à une réalisation |

Possibilité de prolongation en thèse : **oui**

Durée du stage : Minimum : 5 Maximum : 6

Période souhaitée : April – September 2022

PROFIL DU STAGIAIRE

Connaissances et niveau requis :
Fluids mechanics

Ecoles ou établissements souhaités :