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THE FRENCH AEROSPACE LAB

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PROPOSITION DE STAGE EN COURS D'ETUDES

Référence : **DAAA-2025-40**
(à rappeler dans toute correspondance)

Lieu : Centre ONERA Châtllon

Département/Dir./Serv. : DAAA

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Responsable du stage : Jacques Peter

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DESCRIPTION DU STAGE

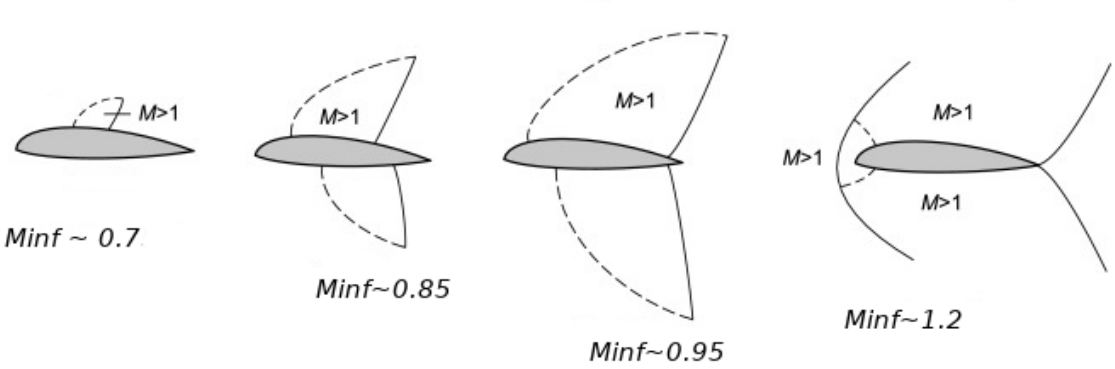
Thématique(s) : Exploitation de données expérimentales et numériques

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

Intitulé : Prediction of transonic flows by learning optimal transportation

Sujet : Aeronautical flows are often predicted in series in which the solid shape or the aerodynamic conditions are varied. The recent and strong development of learning methods has initiated studies aimed at predicting by these techniques a part of the flows of a series while the others, calculated by an aerodynamic simulation code, serve as a learning base. However, the presence of one (or more) shock wave(s) in the flows of interest poses specific problems, hindering many usual methods which ultimately make their prediction by a linear combination of flows of the learning base. In this internship, we will focus on a method recently proposed to overcome this problem, the search for an optimal transport function [1][2].

For perfect fluid flows around a wing profile, for a design of experiments of aerodynamic conditions (Minf, AoA), we will define parametric transport functions to be optimized to reduce the prediction error of an aerodynamic variable. To avoid difficulties in preserving the fluid domain [2], we will work on structured meshes and express the transport functions in the index domain. In a second step, we will predict not only a dimensionless field but all the aerodynamic variables also enforcing consistency with the physical laws of Euler flows. In a third step, we will adapt the method to a large experimental design presenting several types of shock position (see figure). If time permits, we will extend this work to viscous flows around a profile.



Shockwaves are flow discontinuities posing a specific problem to learning methods

Typical evolution of their number and position about an airfoil varying the Mach number at low angle of attack

[1] B. Levy, E. Schwindt. Notions of optimal transport theory and how to implement them on a computer. Computers and Graphics (2018)

[2] A. Iollo, T. Taddei. Mapping of coherent structures in parameterized flows by learning optimal transportation with Gaussian models. Journal of Computational Physics. (2022)

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

Méthodes à mettre en œuvre :

- ■ Recherche théorique
- ☐ Recherche appliquée
- ☐ Recherche expérimentale
- ☐ Travail de synthèse
- ☐ Travail de documentation
- ☐ Participation à une réalisation

Possibilité de prolongation en thèse :

Durée du stage : Minimum : 5 mois Maximum : 6 mois

Période souhaitée : 5 ou 6 mois entre février et septembre 2025

PROFIL DU STAGIAIRE

Connaissances et niveau requis :	Écoles ou établissements souhaités :
Master 2 (éventuellement Master 1) dominante Mathématiques Appliquées	Grande École ou Université