THe **M2N** laboratory (Mathematic modeling and Numeric) of the CNAM proposes a traineeship of 5-6 months in collaboration with the Startup **TourbillOnde**
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5-6 months traineeship for master 2 degree: « aero-acoustic optimization with shape morphing technic applied on an aeronautics benchmark »
localization: Paris (CNAM)
Academic level: fifth year of academic study
domain: Research and Development
skill: numerical methods, signal processing, machine learning techniques

Period : 5–6-months, possible start between January and march 2026;
Renumeration: 635 €/month + 50% for pass Navigo (Paris public transport)

- Mission :

In a context of reducing $CO_2$ emissions in aeronautics, aerodynamic optimization with numerical methods by shape modification is an interesting opportunity to complement the results obtained in the wind tunnel.

A lot of research is therefore underway to create replacement models using *machine learning* techniques and select the hyperparameters leading to the most accurate prediction model.

This internship is broken down into several stages:

- Creation of a velocity and pressure database for flows around a wing profile equipped with high-lift elements with a Boltzmann lattice solver.

- Exploration of the geometric parameter space to test models of multilayer neural networks.

- Optimization of lift and drag force by a gradient descent method.

- Calculation of far-field sound pressure level by DMD (Modal Dynamics Decomposition) method

The trainee will be supervised by Iraj Mortazavi, Professor at the CNAM and Philippe Gilotte from the company TourbillOnde.
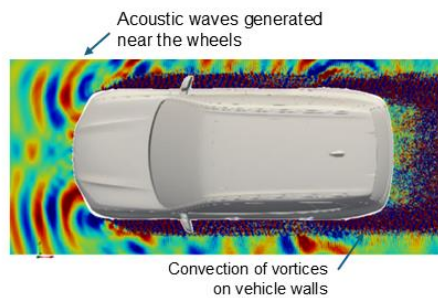
The creation of the models and the realization of the calculations will be carried out on a GPU server at the CNAM, with a suite of software already validated on an automotive configuration (see figure below).
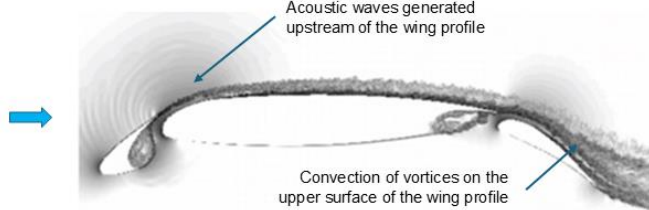
Profile sought:

Candidate in Master 2 degree in mechanics or applied mathematics with skills in computational fluid dynamics, scientific computing, simulation methods and if possible, with first experience with CFD tools.

Physical sense, a spirit of synthesis and an interest in numerical simulation are required.
A first approach to raising awareness of signal processing and machine learning techniques (internal project, internship) would be a plus.

- Example of aero-acoustic computations:



Acoustic waves generated near the wheels

Convection of vortices on vehicle walls

Results presented in 2023 at the CNRS workshop : control of detachments

Acoustic waves generated upstream of the wing profile

Convection of vortices on the upper surface of the wing profile

High lift noise on ONERA's page:
https://www.onera.fr/fr/mfe