JOB OFFER – STAGE

Turbomachinery noise prediction

OFFER INFORMATION

Reference: AAM-2025-DAV-01
Team: AAM

Location: 42 Avenue Gaspard Coriolis – 31057 Toulouse

Supervisors:

- Guillaume Daviller, daviller@cerfacs.fr
- Carlos Montilla, montilla@cerfacs.fr

Gratification: 700€ net per month - M2 level or last year at engineering school
Period: 6 months – from Février 2025 (adaptative)

Mots-clés : Turbomachine, CFD, Analogie acoustique

CERFACS

Cerfacs is a private research, development, transfer and training center for modeling, simulation and high-performance computing. Cerfacs designs, develops and proposes innovative software methods and solutions to meet the needs of its partners in the aeronautics, space, climate, environment and energy sectors. Cerfacs trains students, researchers and engineers in simulation and high-performance computing.
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HOSTING TEAM - AAM

The Advanced Aerodynamic & Multiphysics (AAM) team is dedicated to developing cutting-edge numerical methods, physical modeling, and High-Performance Computing (HPC) techniques for new Computational Fluid Dynamics (CFD) solvers. The work focuses on fluid dynamics simulations for aircraft, rockets, and turbomachinery, in close collaboration with Cerfacs partners.

CONTEXT

Optimizing the propulsive efficiency of aircraft and helicopter engines, and reducing noise and greenhouse gas emissions, are major challenges for the future. In this context, numerical simulations are increasingly used to improve aircraft performance while reducing development costs. It is therefore imperative for the aeronautical industry to reduce calculation times. In particular, achieving numerically the acoustic certification of an aircraft at take-off represents a current challenge.

To this end, hybrid methods are envisaged to propagate the acoustic fluctuations of an aircraft over several hundred meters. First, the flow and noise sources are calculated using an unsteady Navier-Stokes solver on a restricted domain around the aircraft. The noise is then propagated in the far field using an acoustic analogy.

One of the most famous methods in the aeroacoustic community is the Ffowcs-Williams & Hawking integral method with advanced time formulation [1]. However, a frequency formulation exists [2] to avoid additional time integration that would add to the computational cost of a complete turbomachinery fan (with a 360-degree moving mesh).

[1] D. Casalino. *An advanced time approach for acoustic analogy predictions.* Journal of Sound and Vibration, 261, 2003.
[2] D. P. Lockard. *An Efficient, Two-Dimensional Implementation of the Ffowcs Williams and Hawkings Equation*. Journal of Sound and Vibration, 229, 2000.

MISSION

This internship will aim to develop a Ffowcs-Williams & Hawking solver with a frequency formulation. The candidate will develop a Python code for turbomachinery noise prediction to be integrated into the CFD processing library Antares (https://cerfacs.fr/antares), used by Airbus and Safran. This code will be tested on various academic and industrial applications, enabling us to discriminate between the performance of the frequency-based approach and that of the existing time-based method. First, the candidate will familiarize himself/herself with the code and the methods dedicated to acoustic propagation. Then, in collaboration with researchers from the AAM team, the candidate will propose solutions enabling the best possible integration of the envisaged formulation.

DESIRED PROFILE

- Currently in the final year of an engineering degree or equivalent, specializing in Aeronautics, Aerodynamics, and Acoustics.
- Initial project-based experience in unsteady computational fluid dynamics (CFD) programming is required.
- In particular, skills in acoustics are an advantage.
- As this is a research-oriented internship, the candidate, who is preparing for a Research Master's degree, will be required to present his/her work both orally and in writing in English, in line with the standards expected in an international research laboratory.

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HOW TO APPLY?

To apply, please send your CV and cover letter to **daviller@cerfacs.fr**, applications are open until **31/01/2025**.

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