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JOB OFFER – POST-DOCTORAL

High-Fidelity Numerical Simulation for Aeroacoustics using a Lattice Boltzmann Method

OFFER INFORMATION

Reference: AAM-2026-PW-03
Team: AAM

Location: 42 Avenue Gaspard Coriolis – 31057 Toulouse
Contact person: WERNER Paul

Period: 1 year - from: 01/01/2026
Salary: 42K€/year (gross)
Level of education required: PhD.

Key words: LBM, Aeroacoustics, Jet Noise, HLD Noise

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.
Cerfacs works closely with its seven partners: Airbus, Cnes, EDF, Météo France, Onera, Safran et TotalEnergies.

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.Among the innovative numerical approaches developed by the team is the Spectral Difference Method (SDM), a high-order discontinuous method particularly well-suited for high-fidelity unsteady simulations. This technique enables the fine resolution of turbulent structures while being highly optimized for modern parallel architectures. In parallel, the team contributes to the development of solvers based on the Lattice Boltzmann Method (LBM), a promising alternative to traditional methods, recognized for its algorithmic simplicity, natural ability to handle complex geometries, and outstanding HPC capabilities. Together, these two approaches provide complementary solutions for efficiently modeling realistic flows in complex industrial environments.

CONTEXT

The aviation industry faces the major challenge of reducing its environmental footprint (CO_2 emissions, noise pollution). To address this, breakthrough aircraft and engine architectures are currently under development (e.g., Ultra-High Bypass Ratio (UHBR) engines, Openfan-type unducted fans). These innovations give rise to highly complex unsteady aerodynamic phenomena, the accurate prediction of which is a strategic imperative, particularly regarding aeroacoustics.

In this context, traditional computational fluid dynamics methods (Navier-Stokes) are showing their limitations in terms of turnaround time for these highly separated, turbulent, and compressible flows. The Lattice Boltzmann Method (LBM), which forms the core of the LaBS/ProLB solver, represents a highly attractive alternative. Its

intrinsically unsteady and massively parallel formalism is particularly well-suited for simulations on supercomputers. Coupled with simplified meshing strategies for complex geometries (immersed boundaries, octree grids), the LBM drastically reduces simulation times while capturing the fine physics of turbulence, the primary source of aerodynamic noise, with high fidelity. Recently, major scientific breakthroughs have equipped the solver with a high-Mach compressible core [1] and advanced hybrid turbulence methods (ZDES) [3, 4], yielding excellent results on academic configurations.

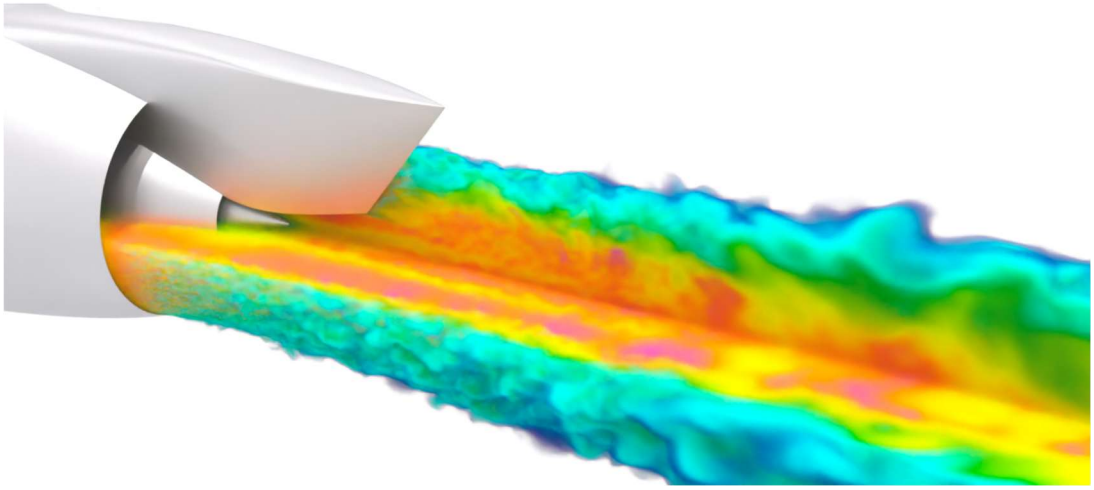
This postdoctoral position is at the heart of a major collaborative research project that brings together Cerfacs, leading industrial partners (e.g., Airbus, Safran), and prominent research centers (e.g., ONERA, ECL, M2P2) to develop and apply cutting-edge approaches. The overarching ambition of this postdoc is to achieve a major technological leap: transitioning from academic validation to high-fidelity simulations on much more complex, realistic industrial geometries.

MISSION

Within the AAM research team at Cerfacs, your primary mission will be to perform, analyze, and validate large-scale LBM simulations on supercomputers (HPC) to address complex industrial challenges in aerodynamics and aeroacoustics.

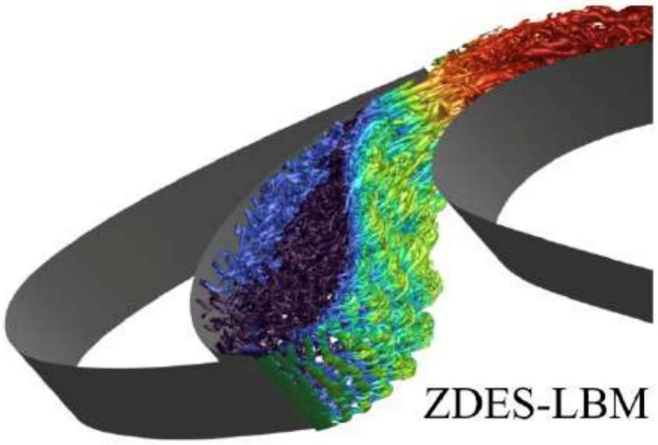
More specifically, relying on the high-Mach compressible version of the LBM solver and its ZDES models, your work will focus on the following areas:

- **Installed dual-stream jet noise**: Perform massively parallel simulations on a configuration modeling a high-subsonic jet installed under a wing. The objective is to validate the capability of the high-Mach compressible solver [1] to predict jet development and its acoustic radiation in a configuration representative of a modern engine. This study is a prerequisite for even more complex engine integration simulations.



DJINN Baseline configuration – Instantaneous velocity magnitude [2]

- **High-lift airfoil noise**: Demonstrate the predictive capabilities of the ZDES turbulence model on realistic industrial geometries (e.g., FNGY high-lift wing or equivalent). The goal will be to accurately capture complex turbulent flows (such as flow separation in the slat and flap coves).



Isosurfaces of Q-criterion colored by velocity magnitude for ZDES-LBM [3]

- **Aeroacoustic coupling (FW-H):** Set up the complete acoustic prediction chain. You will use the unsteady aerodynamic fields generated by the LBM to propagate the radiated noise to the far field (spectra, directivities) via a coupling with the Ffowcs-Williams & Hawkings (FW-H) tool developed at CERFACS (Antares library).

- **Scientific dissemination:** Because the simulated configurations represent the state of the art, a significant part of your mission will involve disseminating your results by writing articles for peer-reviewed international journals and delivering presentations at major conferences (AIAA, CEAS, etc.).

Depending on the project's needs and the candidate's interests, the mission may also include development activities within the solver's environment (in C++) to implement or improve specific physical models.

[1] G. Farag, T. Coratger, G. Wissocq, S. Zhao, P. Boivin, and P. Sagaut, A unified hybrid lattice-boltzmann method for compressible flows: bridging between pressure-based and density-based methods, Phys. Fluids **33**, 86101 (2021).

[2] G. Daviller, E. Charles, J. F. Boussuge, F. Renard, and J. Huber, *Investigation of Jet-Pylon Interaction Noise Using LBM*, in *30th AIAA/CEAS Aeroacoustics Conference (2024)* (American Institute of Aeronautics and Astronautics, Rome, Italy, 2024).

[3] Julien Husson, Marc Terracol, Sébastien Deck. ZDES of the flow past a three element airfoil : a comparison between Navier-Stokes and lattice Boltzmann frameworks. ETMM 14, Sep 2023, Barcelone, Spain.

[4] J. Husson, M. Terracol, and S. Deck, *Numerical Study of Flap Side-Edge Vortex Based on the Combination of Zonal Detached Eddy Simulation and Lattice-Boltzmann Method | Aeroacoustics Conferences*, in (American Institute of Aeronautics and Astronautics, Rome, Italy, 2024).

DESIRED PROFILE

- PhD defended less than 3 years ago.
- **Required technical skills:**
  - Solid expertise in Computational Fluid Dynamics (CFD), particularly in high-fidelity unsteady methods (LES, DES, ZDES).
  - Prior knowledge of the Lattice Boltzmann Method (LBM) and/or acoustic analogies (FW-H) is a major asset.
  - Proven experience in High-Performance Computing (HPC) on supercomputers (parallel architectures, Linux/Unix environments, batch management).
  - Proficiency in one or more programming languages (Python, C++, Fortran) for processing and analyzing massive datasets.

- Strong enthusiasm for teamwork within a highly collaborative ecosystem blending academic research and industrial challenges.

- **Personal qualities:**
  - Scientific rigor and strong analytical skills.
  - Autonomy, curiosity, and proactivity.
  - Strong interest in applied research linked to industrial challenges.
  - Excellent interpersonal skills and the ability to work effectively within a collaborative research team.

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- A complementary health insurance scheme offering excellent health care coverage in addition to social security, with the possibility of enrolling family members (spouse and children).
- 6 weeks' annual leave (with the possibility of 22 extra days' leave per year linked to your choice of a 39-hour rather than 35-hour working week).
- Flexible working arrangements, with the possibility of working from home up to two days a week.
- A sustainable mobility package enabling employers to pay up to a maximum of 500 euros a year to cover the home-to-work travel costs of staff who cycle to work.

HOW TO APPLY ?

To apply, please send your CV and covering letter to werner@cerfacs.fr, applications are open until 31/12/2026.

See you soon at Cerfacs!