

– Postdoctoral Fellowship –
Goal-Oriented Multi-Fidelity Strategies for the Prediction of Turbulent
Flows
(MOST Team, LEGI, Grenoble)
Duration: 18 months, renewable.

Scientific Background

Numerical simulation of turbulent flows always involves a trade-off between accuracy and computational cost. Depending on the objectives, different modeling approaches can be employed, including RANS simulations, hybrid RANS/LES methods, Large-Eddy Simulation (LES), and various geometric or physical simplifications. Each of these approaches has its own level of fidelity, computational cost, and range of applicability.

In many practical applications, several simulation strategies may be used to address the same scientific or industrial question. For example, in rotor/stator configurations, one may rely on RANS simulations with mixing planes, hybrid RANS/LES approaches, LES on simplified geometries, or LES of the full geometry. In practice, the choice of the most appropriate strategy is still often based on user experience rather than on a quantitative methodology.

For several years, the MOST team at LEGI has been developing advanced simulation methods within the YALES2 framework, covering a wide spectrum from RANS approaches to high-fidelity LES with automatic mesh adaptation. In parallel, recent work has led to the development of multi-fidelity modeling strategies that combine numerous low-cost simulations with a smaller number of more accurate but computationally expensive simulations.

Objectives of the Postdoctoral Project

The objective of this project is to develop a methodology capable of automatically selecting the simulation strategy best suited to a given prediction objective, while optimizing the trade-off between accuracy and computational cost.

The work will build on multi-fidelity modeling approaches combining simulations of different fidelity levels, ranging from RANS calculations to high-fidelity LES, possibly associated with various levels of geometric or physical simplification. Particular attention will be paid to uncertainty quantification and to the definition of criteria that assess the contribution of each simulation to the improvement of the prediction.

The developments will also aim to extend existing approaches, which are often restricted to integrated quantities, to the reconstruction of complete statistical fields. The ultimate goal is to design a goal-oriented strategy capable of determining, for a given quantity of interest (efficiency, forces, losses, fluctuations, etc.), which simulations should be performed and at what fidelity level in order to achieve the desired accuracy at minimal cost.

Working Environment

The successful candidate will benefit from a highly recognized scientific environment, access to high-performance computing resources, and strong interactions with both academic and industrial partners.

Candidate Profile

- PhD in fluid mechanics, physics, applied mathematics, or a related field,
- Experience in numerical simulation and/or modeling and/or data science,
- Strong interest in collaborative research.

Application Procedure

Applicants should send the following documents by email (thomas.berthelon@univ-grenoble-alpes.fr): CV, list of publications, Cover letter, Contact information for references.

Contact

For any questions or informal discussion, candidates are encouraged to contact Thomas Berthelon at thomas.berthelon@univ-grenoble-alpes.fr.