Type d'offre : Laboratory offer

Post date : 19.02.25

MINES Paris | PSL

M2 Internship - Generation of Velocity Fluctuation Correlations in Hybrid RANS/LES Models Using Forcing Terms

Informations générales

Contract type : Stage

Contract length : 6 months

Contact :

Aurélien Larcher / **Jonathan Viquerat**

Starting date : Tue 01/04/2025 - 12:00

Trade : Technicien

Topic : IHM et visualisation données

MINES Paris | PSL :

The PSL University (Paris Sciences et Lettres) was born out of the long intellectual and scientific history of its institutions, which through it have decided to build a common future. PSL is a global university dedicated to education and research at the highest level, with the ambition of representing and influencing society and the world of the future in all its diversity. Its collegiality is an asset: it enables it to bring together all fields of knowledge, innovation and creation, in the sciences, humanities and social sciences, arts and engineering. In 2012, École Mines Paris joined Idex Paris Sciences et Lettres as a founding member. Today, it is one of the 11 institutions of the PSL University.

Détail de l'offre (poste, mission, profil) :

Context

Different approaches can be used to simulate incompressible turbulent flow problems, depending on the time and space scales to be resolved. Direct numerical simulation (DNS) using numerical methods unaffected by the Gibbs phenomenon aims to resolve the entire energy spectrum, and can therefore only be applied to so-called “die” simulations due to computational requirements. Consequently, two main approaches have been used in practice for engineering applications: Reynolds-averaged Navier-Stokes (RANS) models and large turbulence simulation (LES). The first approach is ensemble-averaged and often relies on the calculation of a turbulent viscosity based on one or more turbulent scales that are governed by equilibrium equations, e.g. k the turbulent kinetic energy and epsilon the energy dissipation rate. The calculated velocity and pressure fields can therefore be considered as averaged in space (below the mesh resolution) and time (in a direction to be defined), so that they do not preserve the dynamic characteristics of the flow.

The second approach is based on filtering the Navier-Stokes equations so that vortex energy is captured up to the scale defined by the mesh resolution [1], so that its cost is higher than that of the RANS method. To overcome the limitations of each method, hybrid approaches combining RANS and LES using zonal [2] or mixed

techniques have been developed. Flow dynamics are resolved in regions of interest with LES, while RANS is active in regions where the averaging procedure does not degrade flow characteristics, or in the near-wall region. The difficulty of this hybrid approach is to generate velocity fluctuations corresponding to the LES flow dynamics in a buffer region between the RANS and LES zones, for which strategies based on linear forcing have been proposed by IRSN collaborators [3], see figure. The aim of the project is to evaluate different forcing techniques on flat duct and nozzle configurations in order to optimize the generation of velocity fluctuations correlated with flow dynamics.

References

[1] A. Ramanathan Krishnan, Explicit algebraic subfilter scale modeling for DES-like methods and extension to variable density flows, Thèse de doctorat, Université Aix-Marseille, 2019

[2] J. Janin, F. Duval, C. Friess, P. Sagaut, A new linear forcing method for isotropic turbulence with controlled integral length scale. Physics of Fluids, 33(4), 2021

[3] J. Janin, Forçage volumique basé sur une méthode de type reconstruction pour un modèle de fermeture algébrique hybride RANS/LES, Thèse de doctorat, Université Aix-Marseille, 2023

Expected profile

- Master of Science student or equivalent in applied mathematics, physics or mechanical engineering, with skills in fluid dynamics and machine learning ;
- Experience with Python and machine learning tools.

Working Conditions

The proposed work will be carried out in the Computing & Fluids research group. This grant covers a 6-month internship starting in the first half of 2025. Place of work: CEMEF - MINES Paris PSL, 1 Rue Claude Daunesse, Sophia-Antipolis, France.

Closing date for submitting applications : Mon 31/03/2025 - 12:00

URL de l'offre : https://www.dataia.eu/sites/default/files/OffreStageM2MITI.pdf

Lien vers l'offre sur le site dataia.eu :https://da-cor-dev.peppercube.org/node/1240