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CALL FOR APPLICATIONS

Postdoc fellowship – Optimization of an Immersed boundary Method (IBM) library for the analysis of wall-bounded turbulent flows

Having regard to the article L. 412-4 of the research code.

Position to be filled on 1st September 2022
Duration of the contract: 17 months
Workload: 100%
Number of vacancies: 1
Offer reference: *2022-FTC-02*

Department of assignment:
ISAE-ENSMA / Institut P' (UPR CNRS 3346)
Département Fluides Thermique Combustion

Workplaces (in french):
(80%) **R.TECH** – Parc Technologique Delta Sud
10, rue Jean Mermoz – 09340 VERNIOLLE
Département de l'Ariège, Région Occitanie

(20%) **ENSI Poitiers** – Rue Pierre Brousse – 86000 POITIERS
Département de la Vienne, Région Nouvelle-Aquitaine

JOB PROFILE

Candidate's profile: the candidate must have strong competences in the numerical simulation of turbulent flows. A PhD degree in this area of expertise is required. Previous experience using IBM would be a plus.

Eligibility: the candidate must be a French national citizen with a PhD and/or has obtained a PhD in a French Institution. In any case, the PhD diploma must have been delivered during the academic year 2021-2022 (more specifically, the postdoc position will have to end within the 3 years following the PhD defense date). **These eligibility criteria are mandatory.**

Subject : the present research work aims at improving the analysis of complex flow around bodies at high speed, including configurations such as space vehicles, using numerical simulations. For these flows, the accurate prediction of several aspects such as shock waves, heat transfer, turbulence, and surface deterioration are crucial. The boundary of the objects should also be taken into account in a satisfactory manner. To do so, an immersed boundary method (IBM) over a Cartesian grid has been preferred to a classical body-fitted approach. The latter suffers from several disadvantages, not the least being that the numerical cost would be prohibitive for a moving object. R.Tech has developed a library called CYCLONE to include bodies within the computational domain by using the IBM forcing method [1-2]. The objective of this postdoc position is to improve this library, possibly by incorporating a different type of IBM method, such as the sharp interface method [3-4], which is presently under investigation at Pprime Institute. This should lead to an increase of the order of accuracy of the CYCLONE library.

Objectives : the work of the candidate will aim for the development of three synergic tasks, which are listed in the following:

1. Implementation of an interface between the library CYCLONE and an in-house code at Pprime Institute [5].

2. Development of several physical models within the library, which aim to improve the accuracy of the IBM method.

3. Validation of the models developed with application to test cases, such as a heated cylinder [6].

References:

- [1] A. Pinelli, I. Naqavi, U. Piomelli et J. Favier, «Immersed Boundary Method for generalised Finite Volume and finite Difference Navier-Stokes Solvers.,» Journal of Computational Physics, vol. 229, n° 124, pp. 9073-9091, 2010.
- [2] E. Constant, J. Favier, M. Meldi, P. Meliga et E. Serre, «An immersed boundary method in OpenFOAM : Verification and validation,» *Computers & Fluids,* vol. 157, pp. 55-72, 2017
- [3] R. Ghias, R. Mittal et H. Dong, «A sharp interface immersed boundary method for compressible viscous flows,» J. Comput. Phys., vol. 225, p. 528–553, 2007.
- [4] J. H. Seo et R. Mittal, «A high-order immersed boundary method for acoustic wave scattering and low-Mach number flow-induced sound in complex geometries,» Journal of Computational Physics, vol. 230, p. 000–1019, 2011.
- [5] Sebastian R, Marx D, Fortuné V, Numerical simulation of a turbulent channel flow with an acoustic liner, J. Sound Vib. 456, 306-330 (2019).
- [6] J. G. Wissink et W. Rodi, «Direct numerical simulation of heat transfer from the stagnation region of a heated cylinder affected by an impinging wake,» J. Fluid Mech., vol. 669, p. 64–89, 2011.

SUBMISSION OF APPLICATION

CV and **cover letter** should be sent to: recrutement.rh@ensma.fr (quoting the reference 2022-FTC-02)