

2021-04111 - Post-Doctoral Research Visit F/M h-adaptation strategies and unified basis representation for surrogate and reduced order modelling of fluid flows with immersed/embedded parametrized geometries

Type de contrat : CDD
Contrat renouvelable : Oui
Niveau de diplôme exigé : Thèse ou équivalent
Fonction : Post-Doctorant
Niveau d'expérience souhaité : Jeune diplômé

A propos du centre ou de la direction fonctionnelle

The Inria Bordeaux Sud-Ouest centre is one of Inria's eight centres and has around twenty research teams. The Inria centre is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative SMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute...

Contexte et atouts du poste

Within the framework of the European project EuroHPC-02-2019 [eflows4HPC](#), and in collaboration with the partners of the pillar I of the project: CIMNE, SISSA, SIEMENS and Duke University.

With hosting by the Inria Bordeaux Sud-Ouest research center and regular travel foreseen within the activities and collaborations mentioned above.

Developments contributing to the open source projects [mmg](#) and [kratos multiphysics](#), as well as the model reduction libraries [RBniCS](#) and the ITHACA suite by Sissa, and some in house research codes for some of the initial methodological developments. Where possible workflows environments developed at the Barcelona Supercomputing Center (coordinator of [eflows4HPC](#), see for example [comps](#)) will be used to allow an efficient and transparent management of data, computational resources, and processes.

Mission confiée

Assignments :

The main objective of this work is to develop improved adaptive remeshing techniques in the framework of model reduction and optimization with parametrized geometries, and in particular in conjunction with immersed and/or embedded boundary simulations. The purpose is twofold:

- on one side to propose an efficient (in terms of storage) and unified spatial basis setting to represent multiple solutions on unstructured adaptive meshes. This requirement is essential to provide an efficient unified representation of multiple solutions on adaptive meshes in a parametrized setting. This representation is necessary for several operations related to inverse modelling, of model reduction (e.g. method of snapshots), to compute statistics etc.
- on the other hand we aim at exploiting the information available in a parametrized setting to speed up the adaptation process itself by e.g. constructing appropriate surrogate models of mesh metrics or error estimators

These assignments will both involve theoretical work related to error estimation and approximation in physical and parametric space, with a final demonstration in an efficient setting involving workflows developed at the Barcelona Supercomputing center and based on open source software developed at Inria, Cimne, and at Sissa.

For a better knowledge of the proposed research subject :

N. Barral, G. Olivier and F. Alauzet, *Time-accurate anisotropic mesh adaptation for three-dimensional time-dependent problems with body-fitted moving geometries*, Journal of Computational Physics, 2017

Baiges, J, Codina, R, Castañar, I, Castillo, E. A finite element reduced-order model based on adaptive mesh refinement and artificial neural networks. *Int J Numer Methods Eng.* 2020; 121: 588– 601.

Barros, G.F, Grave, M., Viguier, A. *et al.* Dynamic mode decomposition in adaptive mesh refinement and coarsening simulations. *Engineering with Computers* (2021). <https://doi.org/10.1007/s00366-021-01485-6>

M. Balajewicz and C. Farhat, Reduction of nonlinear embedded boundary models for problems with evolving interfaces, *Journal of Computational Physics* 274, 2014 : 489-504,

Collaboration :

The recruited person will be working with several members of the team, and in particular N. Barral, H. Beaugendre and M. Ricchiuto. Interactions with local experts in model reduction (e.g. T. Taddei, Memphis team) are envisioned. Strong interactions with the partners of the pillar I of the [eflows4HPC](#) European project (CIMNE, SISSA, SIEMENS and Duke University) are foreseen.

Principales activités

Main activities :

- adaptation strategies for multiple solutions: one way coupling using metric intersections
- development of new coupling strategies based on space-time-parametric space error estimators

Informations générales

- **Thème/Domaine :** Schémas et simulations numériques
Calcul Scientifique (BAP E)
- **Ville :** Talence
- **Centre Inria :** [CRI Bordeaux - Sud-Ouest](#)
- **Date de prise de fonction souhaitée :** 2022-04-01
- **Durée de contrat :** 12 mois
- **Date limite pour postuler :** 2022-02-28

Contacts

- **Equipe Inria :** [CARDAMOM](#)
- **Recruteur :**
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A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3500 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 180 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

We are looking for a motivated and ambitious candidate, ready to work in a truly international environment

and in a team involving collaborators from different horizons (applied math, engineering, computer science).

Consignes pour postuler

Thank you to apply on the site with these documents :

- CV
- Cover letter
- Support letters (mandatory)
- List of publication

Sécurité défense :

Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

Politique de recrutement :

Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

Attention : Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas

- smart surrogate error modelling for mesh adaptation speed up
- applications to academic benchmarks
- evaluation on realistic heat transfer/fluid flow applications using the coupling kratos multiphysics-mm-g-ithaca (or RBniCS)

Additional activities :

- publications (journal articles, conference presentations)
- participation to official meetings and (partly) management within the **eFlows4HPC** project
- (co-) supervision (master students and perhaps of a R&R engineer)

Compétences

Technical skills and level required :

Proficient in numerical methods for fluids on unstructured grids. Knowledge in approximation theory, error estimation, and mesh generation/adaptation

will be greatly appreciated. Some basic knowledge of surrogate modelling and/or model reduction method will be also evaluated favourably.

Proficiency in object oriented programming, and some basic understanding of his performance computing techniques is required.

Languages : Proficiency in English is a must

Relational skills : ready to work in a truly international environment, within a multicultural team, and to interact

with collaborators from different horizons (applied math, engineering, computer science).

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération

the gross monthly salary will be 2653 euros (before social charges on salary and monthly withholding taxes for income)