

Offre n°2019-01839

PhD Position F/M Asynchronous Parallel In Time Algorithms for Data Assimilation

Le descriptif de l'offre ci-dessous est en Anglais

Type de contrat :CDD

Niveau de diplôme exigé :Bac + 5 ou équivalent

Fonction :Doctorant

A propos du centre ou de la direction fonctionnelle

Grenoble Rhône-Alpes Research Center groups together a few less than 800 people in 35 research teams and 9 research support departments.

Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas.

Present in the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

Contexte et atouts du poste

Team Presentation:the general scope of the AIRSEA project-team (<http://team.inria.fr/airsea/>) is to develop mathematical and computational methods for the modeling of oceanic and atmospheric flows. The used mathematical tools involve both deterministic and statistical approaches. The domains of applications range from climate modeling to the prediction of extreme events.

This PhD position is funded by ANR in the context of the ADOM (Asynchronous Domain Decomposition) project. Other partners of this project are CentraleSupelec, LMT (ENS Paris-Saclay), FEMTO-ST and Safran Tech.

Mission confiée

Variational data assimilation[1] is a very common method for the initialisation of numerical models. It is widely used for instance in Numerical Weather Prediction systems (Meteo-France, UK MetOffice, ...). It aims at finding an optimal initial solution that will bring the model trajectory closer to observations of the system over a given time window. This is done using optimal control techniques where a cost function depending on the sought initial condition is minimised using an iterative method. Schematic representation of the parareal algorithm Recent trend in computing resources leads to a spectacular increase in the number of numerical cores while the efficiency of said cores remain stable. This implies that new sources of parallelism have to be found in demanding applications. Even though the model can be fully parallel, variational data assimilation algorithms are by essence sequential (minimisation). A possible way out is to increase parallelism through the time dimension using Parareal[3]- or Pita[2]-type approaches. Here a coarser (cheaper) problem is solved on the entire time window, then the time dimension is split into separate sub-windows where the full problem is solved in parallel starting from initial conditions given by the coarser solution. This process is iterated several times until convergence. Another consequence of this ever rising number of computing units is the increase of the probability of a hardware failure. This led to the development of asynchronous methods that could cope with such failure as well as heterogeneity in the computing nodes [3]

Bibliography

[1] E. Arnaud : Lecture notes in inverse methods and data assimilation. https://team.inria.fr/airsea/files/2018/11/Poly_InvMet-M2.pdf

[2] Cortial, J. and Farhat, C. (2009). A time-parallel implicit method for accelerating the solution of non-linear structural dynamics problems. International Journal for Numerical Methods in Engineering, 77(4), 451–470.

[3] Maday, Y. and Turinici, G. (2002). A parareal in time procedure for the control of partial differential equations. C. R. Acad. Sci. Paris, Ser. I, 335(4), 387–392.

[4] F. Magoules, C. Venet. (2018). Asynchronous iterative substructuring methods. In Mathematics and Computers in Simulation 145 :34-49.

Principales activités

The topic of this PhD is to perform a theoretical study of the interactions between iterations of the data assimilation minimisation and those of the parallel in time algorithm. Specific focuses will be on their convergence properties and on proper and efficient ways of preconditioning. This will then be illustrated on a simple idealized test case. This study will then be extended to asynchronous parallel in time algorithms and to more complex experiments with application to ocean modelling. This is primarily an applied mathematics research proposal, with applications to high performance computing.

Compétences

- strong interest in applied mathematics and a taste for computer sciences.
- Basic knowledge in numerical analysis and optimisation.
- Programming skills in python and/or Fortran.

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

1st and 2nd year : 1 982 euros brut /month

3rd year : 2 085 euros brut / month

Informations générales

- Thème/Domaine : Sciences de la planète, de l'environnement et de l'énergie
Calcul Scientifique (BAP E)
- Ville : Montbonnot
- Centre Inria : [Centre Inria de l'Université Grenoble Alpes](#)
- Date de prise de fonction souhaitée : 2019-10-01
- Durée de contrat : 3 ans
- Date limite pour postuler : 2019-08-25

Contacts

- Équipe Inria : [AIRSEA](#)
- Directeur de thèse :
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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 215 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3900 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 200 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.

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

Consignes pour postuler

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.