Offre n°2025-08574

PhD Position F/M Computational Bayesian optimal sensor placement for ocean models: a majorize-then-optimize strategy

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

The Centre Inria de l'Université de Grenoble groups together almost 600 people in 23 research teams and 9 research support departments.

Staff is present on three campuses in Grenoble, in close collaboration with other research and higher education institutions (Université Grenoble Alpes, CNRS, CEA, INRAE, ...), but also with key economic players in the area.

The Centre Inria de l'Université Grenoble Alpes is active in the fields of high-performance computing, verification and embedded systems, modeling of the environment at multiple levels, and data science and artificial intelligence. The center is a top-level scientific institute with an extensive network of international collaborations in Europe and the rest of the world.

Contexte et atouts du poste

The PhD thesis will take place at the in the AIRSEA team (https://team.inria.fr/airsea/en/) of the Inria Centre at the University Grenoble Alpes.

Mission confiée

Where should one observe a given system in order to maximize knowledge about it? This question lies at the core of **optimal sensor placement** and is critical in numerous applications, especially in **ocean modeling**, where data acquisition can be costly (e.g., satellite observations, ocean buoys, underground drilling, etc.). While computational Bayesian optimal experimental design (BOED) is relatively straightforward for linear models with Gaussian priors, the challenge grows significantly with realistic operational models. These models are often nonlinear, exhibit non-Gaussian behaviors, and are computationally expensive to evaluate, making the BOED problem much more demanding from a computational perspective.

Recently, a gradient-based approach has been proposed to alleviate this computational burden [1]. The strategy behind this approach is to minimize a bound of the so-called Expected Information Gain (EIG), which is relatively easy to work with, rather than minimizing the EIG itself. In principle, this bound serves as a surrogate for the EIG which providing a computationally favorable way to guide the sensor placement. This is because the error-bound can be evaluated and optimized much more efficiently than the actual error, which requires numerous expensive numerical simulations of the numerical model.

The objective of this project is to address various numerical aspects associated with the gradient-based solution for the BOED problem. The project has three main goals:

1. Firstly, we seek to enhance our understanding of the majorize-then-minimize approach used in the gradient-based solution. We will achieve this by comparing the solutions obtained from the bound-based approach with those obtained from the conventional EIG-based approach. Ultimately, we hope to use the bound-based approach as a preconditioning step for the EIG-based solution to improve its accuracy.
2. Secondly, we will employ randomized linear algebra methods to accelerate the computation of the bound which, for realistic models, can still be quite expensive to compute. This will help to improve the computational efficiency of the gradient-based approach, making it more practical for large-scale systems.
3. Finally, we will address the challenge of incorporating physical constraints into the sensor

placement problem. Specifically, we will investigate how to take into account the constraints (physical/technical/financial) on the way the system can be observed, in order to obtain more realistic and practical sensor placement solutions.

[1] Chen, Arnaud, Baptista, Zahm 2024. “Coupled Input-Output Dimension Reduction: Application to Goal-oriented Bayesian Experimental Design and Global Sensitivity Analysis”. arXiv preprint arXiv:2406.13425.

Principales activités

Compétences

This PhD project sits at the intersection of**high-performance computing, statistics, and machine learning**. Candidates should possess strong expertise in at least one of these fields and a motivation to rapidly develop complementary skills. The project involves both **practical implementations and theoretical developments**. Candidates should demonstrate experiences and skills in scientific creativity, writing, autonomy, oral communication, and a strong enthusiasm for teamwork.

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 (90 days / year) and flexible organization of working hours
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage under conditions

Rémunération

2200 euros gross salary /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 :** 2025-10-01
- **Durée de contrat :** 3 ans
- **Date limite pour postuler :** 2025-03-31

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.

L'essentiel pour réussir

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.