Offre n°2024-08275

Internship: Towards expressive and tractable surrogate models for large scale inverse problems

Niveau de diplôme exigé : Master's or equivalent

Fonction : Internship Research

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 Alpe 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

This internship will be done within an ongoing collaboration between Statify Inria team, Ipag laboratory (UGA), and Inria's software development service.

Recently Inria's Statify research team has developed a scientific library based on the so-called xLLiM (Gaussian Locally-Linear Mapping) model, whose target is the resolution of Bayesian inverse problems using physical direct models and

simulations from them (https://gitlab.inria.fr/kernelo-mistis/kernelo-gllim-is). In the current implementation, the model is learned from training data using a batch implementation requiring to upload all data into memory, which can limit its use to moderate volumes of data. In terms of expressiveness, the current parameterization is tailored for real-valued data and assumes only two options for the noise part of the model.

Contact: in addition to the application to the platform, more information can be requested by contacting florence.forbes@inria.fr, sylvain.doute@univ-grenoble-alpes.fr, stan.borkowski@inria.fr, luc.meyer@inria.fr

Mission confiée

The goal of this internship is to extend the approach with three new functionalities, namely:

- Implementation of an incremental learning of the model parameters to allow reading the data sequentially and going beyond hardware limitations,
- Extension of the noise modelling to parsimonious parametrization by introducing an additional latent component,
- Reformulate the model with complex-valued Gaussian distributions to handle complex valued data.

These improvements should be implemented efficiently in C++ and binded to python.

These functionalities will have to be developed and then implemented in the current GLLiM framework (xLLiM toolbox and application PlanetGLLiM). Validation analyses of the resulting new procedures will have to be conducted, assessing their efficiency, accuracy, and scalability. The goal is to test and improve the performance of the GLLiM model in two specific domains: space remote sensing in high-dimensional settings, and medical imaging analysis, with a particular emphasis on Magnetic Resonance Imaging (MRI).

Principales activités

- Mathematical formulation of one or more extensions for the GLLiM method
- Implementation of the extensions in Python and in C++
- Performing tests and benchmarks
- Integrating your code into the existing xLLiM code base
- Testing for non-regression of xLLiM and PlanetGLLiM
- Writing documentation

Compétences

- Good programming skills in C++ and Python
- Familiarity with probability & statistics, eg. Gaussian mixtures, EM algorithm, Bayesian models
- Solid understanding of mathematics, especially linear algebra and optimization.
- Experience with Github, GitLab, CI, Docker
- Analytical and modeling skills: writing specifications, requirement documents, and user documentation

Avantages

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  - 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

Gratification = 4,35 € gross / hour

Informations générales

- **Thème/Domaine :** Optimization, machine learning and statistical methods Biologie et santé, Sciences de la vie et de la terre (BAP E)
- **Ville :** Montbonnot
- **Centre Inria :** Centre Inria de l'Université Grenoble Alpes
- **Date de prise de fonction souhaitée :** 2025-02-03
- **Durée de contrat :** 6 months
- **Date limite pour postuler :** 2025-12-01

Contacts

- **Équipe Inria :** STATIFY (DGD-I)
- **Recruteur :**
  Borkowski Stanislaw / stan.borkowski@inria.fr

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'e?orce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

Essential qualities in order to fulfil this assignment are:

- Currently pursuing a M2 degree in computer science, applied mathematics, or a related field.
- Solid experience in scientific computing and statistical modeling
- Strong proficiency in software development
- Comfortable in a scientific environment, eager to learn and listen
- Good listening skills and strong interpersonal abilities
- Sense of initiative and responsibility
- Being rigorous and well-organized
- Strong problem-solving skills and the ability to work both independently and in a collaborative team environment.

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

CV + letter

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.