



Offre n°2024-07854

PhD Position F/M Passive imaging for terrestrial and solar seismology

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

Type de contrat : CDD

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Doctorant

Contexte et atouts du poste

We propose a three-years Ph.D. student position in passive imaging for terrestrial and solar seismology. This position is in the context of the ERC-StG project INCORWAVE (<https://ffaucher.gitlab.io/erc-incorwave/>) and takes place in the team Makutu, located at the University of Pau and Pays de l'Adour, in the Southwest of France.

Travel expenses for participation in conferences, workshops, and research stays are also covered within the project.

Mission confiée

The objective of the Ph.D. thesis is to investigate and develop accurate methods and software for passive imaging. In terrestrial and solar seismology, surface oscillations are measured and used to infer the inner structures. These oscillations relate to the propagation of waves through the medium, propagation that depends on the inner physical properties such as density, bulk modulus, meridional circulation, etc. Therefore, observing the waves allows us to reconstruct the properties we cannot access. In the problems we consider, the waves originate from natural/stochastic events in the interior, and to extract information from the oscillations, we work with the cross-correlation of signals. The cross-correlation can be related to deterministic Green's functions which are solutions to wave equations, [2,3,4], giving us the relation between the physical properties and the observations.

Principales activités

The program will be divided into two main phases, with all software development and numerical implementation performed in the open-source code hawen developed in the team Makutu, <https://ffaucher.gitlab.io/hawen-website/>.

The first objective of the student is to understand the relation between the cross-correlation of signals and deterministic wave solutions. It implies the understanding of the wave equations in solar and terrestrial contexts.

- Derivation of the mathematical relations between the cross correlations and the Green's function depending on the wave equation considered and on the assumption regarding the stochastic nature of the source.
- Development and implementation of the numerical workflow in the open-source code hawen [1] developed in the team Makutu.
- Validation of the numerical simulations.

In the second phase, the inverse problem will be considered. The objective is here to reconstruct the internal structures of the medium from the measured oscillations. The reconstruction follows a nonlinear iterative minimization approach. The physical properties describing the system (such as the bulk modulus for the Earth, or the meridional circulation for the Sun) are iteratively updated to minimize a discrepancy criterion between the measurements and the numerical simulations.

- Formulation of the inverse workflow, in particular with the writing of the adjoint-state method for gradient computation in the context of cross-correlation data.
- Implementation in the open-source code hawen.
- Investigation of efficient inversion of the source covariance term.
Investigation of efficient misfit criterion for inversion.

References

[1] F. Faucher, hawen: time-harmonic wave modeling and inversion using hybridizable discontinuous Galerkin discretization, Journal of Open Source Software, 6 (2021), <https://ffaucher.gitlab.io/hawen-website/>.

[2] L. Gizon and A. C. Birch, Local helioseismology, Living Reviews in Solar Physics, 2 (2005).

[3] N. M. Shapiro and M. Campillo, Emergence of broadband rayleigh waves from correlations of the ambient seismic noise, Geophysical Research Letters, 31 (2004).

[4] N. M. Shapiro, M. Campillo, L. Stehly, and M. H. Ritzwoller, High-resolution surface-wave tomography from ambient seismic noise, Science, 307 (2005), pp. 1615–1618.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking 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

2100€ / month (before taxes) during the first 2 years,

2190€ / month (before taxes) during the third year.

Informations générales

- **Thème/Domaine** : Schémas et simulations numériques
Calcul Scientifique (BAP E)
- **Ville** : Pau
- **Centre Inria** : [Centre Inria de l'université de Bordeaux](#)
- **Date de prise de fonction souhaitée** : 2024-11-01
- **Durée de contrat** : 3 ans
- **Date limite pour postuler** : 2024-07-19

Contacts

- **Équipe Inria** : [MAKUTU](#)
- **Directeur de thèse** :
Faucher Florian / florian.faucher@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'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

The applicant must have a solid background in applied mathematics, in particular in partial differential equations for wave propagation; knowledge in iterative optimization is also warmly recommended. It is necessary that the applicant is familiar with coding. In addition, the applicant is expected to review scientific bibliography and write reports/documentation for its progress, hence a good level in English for all aspects of communications is required.

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

Thank you to send:

- CV
- Cover letter
- Master marks and ranking
- Support letter(s)

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.