



Offre n°2020-02957

Post-Doctoral Research Visit F/M Stochastic Filtering for Surface Evolution Tracking

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

Type de contrat : CDD

Niveau de diplôme exigé : Thèse ou équivalent

Fonction : Post-Doctorant

A propos du centre ou de la direction fonctionnelle

The Inria Rennes - Bretagne Atlantique Centre is one of Inria's eight centres and has more than thirty research teams. The Inria Center 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 PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Contexte et atouts du poste

General Informations

This postdoc is part of a collaboration between INRIA (Institut National de Recherche en Informatique et en Automatique) and IFPEN (Research institute with an international scope in the field of energy, transport and the environment). The postdoc will be located at IFPEN in Rueil-Malmaison (Paris area) and the research will be performed in collaboration with the Fluminance research group in Rennes (Bretagne). We offer a one year contract with a possible extension of 6 months. Remuneration for the postdoc includes a gross salary of 37.5 ke per year, full access to the French healthcare, social care and pension system, as well as several other benefits, like coverage of 50% of Paris public transport fees.

Mission confiée

Context

Salt tectonics is a sub-discipline of structural geology that describes the deformation of structures due to the specific behavior of salt. Having a good understanding of the deformation and stress state both within the salt structures and the surrounding rocks is crucial. Indeed, the presence of salt in a basin affects virtually all aspects of the structural system (for example all kinds of subsurface long-terms storage systems [2, 4]).

The objective of this research is to analyze the movement and deformation of the salt/rock interface over time. Since the underlying physical model is often complex and inaccurate, it needs to be supplemented by time dependent observations to correct the model estimation. IFP Energies nouvelles performed a large number of physically scaled sandbox (analog) experiments using a computed tomography scanner that provides high frequency 3D images. This collection of images mimics the kinematics and structural evolution of complex systems where salt structures are involved. [5, 3].

In order to track the salt/rock interface in these images, the idea is to use a non-linear stochastic filtering algorithm [1] recently developed by the INRIA Fluminance Group. First developed to analyze images from biology and meteorology, this method is promising for salt/rock interface tracking as illustrated on the Fig1.

This postdoctoral research project has three main objectives:

2D stochastic Filtering on cross sections of salt/rock interface images

The INRIA team Fluminance developed a mathematical model that estimates velocities and displacements of a moving interface. In this model, the interface and its evolution is implicitly defined by a level set. At each time step, a N particle filter tries to associate one level set for each particle representing the interface so that the mean level set is the best estimate of the tracked interface at that time

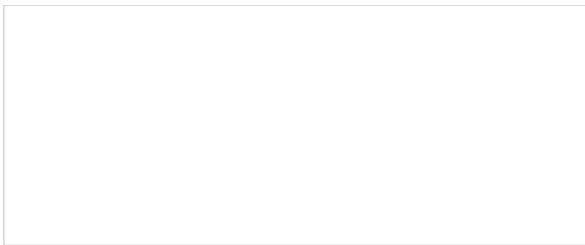


Figure 1: close curve in red that represents salt/rock interface in 2D at one time step

The evolution model established by INRIA team is generic: the first objective of the postdoc will be to get up to speed with the theory and existing source code and adapt it to the case of salt tectonics.

Parallelization strategy and code enhancement

Particle filters are computationally intensive techniques, especially when the state of the particle is an entire 2D image that needs to be estimated at each time step. In order to turn the technique into a practical experimental tool a parallelization strategy will have to be developed by the postdoc. This could range from a classical HPC approach on IFPEN's supercomputer ENER440 (8640 cores up to 445 Tops) to a distributed one on a Hadoop/Yarn cluster.

Extension of dynamic equations to 3D

Once validated on 2D images extracted from 3D image cubes provided by our CT scanner, the theoretical extension of the level set framework is to be investigated. The postdoc should focus on developing evolution models well suited to compute a velocity field and track a 2D surface embedded in a 3D level set.

References

- [1] Christophe Avenel, Etienne Memin, and Patrick Perez. Stochastic level set dynamics to track closed curves through image data. *Journal of Mathematical Imaging and Vision*, 49(2):296-316, June 2014.
- [2] Tobias Baumann, Boris Kaus, and Anton Popov. Deformation and stresses related to the Gorleben salt structure: insights from 3D numerical models. 09 2018.
- [3] J-P Callot, Jean Francois Salel, Jean Letouzey, Jean-Marc Daniel, and Jean-Claude Ringenbach. 3d evolution of salt controlled minibasins: interactions, folding and megaap development. *AAPG Bulletin*, 100, 09 2016.
- [4] Michael R. Hudec and Martin P. A. Jackson. Terra inrma: Understanding salt tectonics. *Earth Science Reviews*, 82(1):1{28, May 2007.
- [5] M. Warsitzka, J. Kley, and N. Kukowski. Analogue experiments of salt ow and pillow growth due to basement faulting and dierential loading. *Solid Earth*, 6(1):9{31, 2015.

Principales activités

Compétences

Qualifications

Candidates should hold a Ph.D. in Computer Science or Applied mathematics (or be near completion), be proficient in English and have excellent programming skills (C++, python). In particular, we look for applicants with experience in image processing and with some stochastic filtering or data assimilation background.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs

Rémunération

monthly gross salary amounting to 2653 euros

Informations générales

- **Thème/Domaine** : Sciences de la planète, de l'environnement et de l'énergie

- Instrumentation et expérimentation (BAP C)
- **Ville** : IFPEN in Rueil-Malmaison (Paris area)
- **Centre Inria** : [Centre Inria de l'Université de Rennes](#)
- **Date de prise de fonction souhaitée** : 2020-12-01
- **Durée de contrat** : 1 an, 6 mois
- **Date limite pour postuler** : 2020-10-19

Contacts

- **Équipe Inria** : [FLUMINANCE](#)
- **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 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

Candidates should send their CV and a short cover letter to Jean-Francois Lecomte ([jean-francois.lecomte\(at\)ifpen.fr](mailto:jean-francois.lecomte(at)ifpen.fr)) and Etienne Mémín (Etienne.Memin@inria.fr)

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

Please submit online : your resume, cover letter and letters of recommendation eventually

For more information, please contact etienne.memin@inria.fr

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.