Offre n°2023-06852

Modeling the present, past, and future of real terrains from in-situ geological annotations

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

Type de contrat : Convention de stage

Niveau de diplôme exigé : Bac + 4 ou équivalent

Fonction : Stagiaire de la recherche

A propos du centre ou de la direction fonctionnelle

The Inria centre at Université Côte d'Azur includes 37 research teams and 8 support services. The centre's staff (about 500 people) is made up of scientists of different nationalities, engineers, technicians and administrative staff. The teams are mainly located on the university campuses of Sophia Antipolis and Nice as well as Montpellier, in close collaboration with research and higher education laboratories and establishments (Université Côte d'Azur, CNRS, INRAE, INSERM ...), but also with the regiona economic players.

With a presence in the fields of computational neuroscience and biology, data science and modeling, software engineering and certification, as well as collaborative robotics, the Inria Centre at Université Côte d'Azur is a major player in terms of scientific excellence through its results and collaborations at both European and international levels.

Contexte et atouts du poste

The internship will take place at Inria Sophia Antipolis, in the GraphDeco group (http://team.inria.fr/graphdeco), supervised by Adrien Bousseau and Guillaume Cordonnier, and in collaboration with BRGM.

Inria will provide a monthly stipend of around 1400 euros for EU citizens in their final year of masters, and ~600 euros for other candidates.

Mission confiée

Context and goal

One of the fundamental challenges of geology is to understand the soil, the subsoil and its history, which makes it of great importance to society. Mapping the different types of underground rocks is key to an optimal access to water and natural resources. Knowledge of soils and their chemical composition helps ensure the viability of certain plant species, and thus protect biodiversity. Finally, the study of the physics and history of landscapes improves understanding of risks, enabling to anticipate and prevent landslides, floods, coastal erosion.

Geologic knowledge is first acquired in the field. Geologists observe the geometry and composition of the subsoil where rock structures outcrop. They record their observations in field notebooks with sketches, annotations, various notes and measurements, as illustrated in Figure 1a. This information is subsequently analyzed and used to draw up geological maps, and to create 3D models of the subsoil structure (Figure 1b).

However, translating field observations into geologically-consistent 3D models is a tedious manual process. First, experts need to make numerous assumptions and hypotheses to deduce complete underground structures from sparse observations and measurements. Second, existing tools focus on specifying the static 3D geometry of the soil at the time of observation rather than reasoning about the sequence of past geological events (sedimentation, uplift, crustal folding and faulting, erosion) that resulted in this geometry [1].

Our goal is to inform the creation of geological maps by modeling the history of the soil. Accounting for the events that caused specific geological structures will help experts decide among concurrent interpretations of the field observations, will help deduce the geometry of these structures in-between
observations, and will allow simulating the evolution of these structures through time, in the past and in the future [2].

**Approach**

Our long-term goal is to provide a modeling tool that infers past geological events from present observations of the soil structures. Achieving this goal entails several sub-goals, which we plan to explore as part of this internship:

1. Study the most common geological events and formulate constraints that each event implies on soil structures. For example, sedimentation comes from the deposition and solidification of particles transported by fluids (air, rivers, oceans), with the associated constraint that sedimentation only adds material with a flat surface. We will collaborate with the French institute on geology BRGM to perform this study, and build on existing literature on geologic modeling [3,4].
2. Define a spatio-temporal representation of the soil suitable for geometric modeling of the geologic structures and their evolution. Prior work proposed different representations of the static geometry of the soil, including implicit surfaces [5] and heightfields [6]. The key challenge will be to adapt these data structures to model transformations of the geometry through geological events.
3. Implement a 3D modeling tool [7] that allows users to create soil structures by sketching the same annotations as they do in field observations. The tool will translate these annotations into geologically-sound structures by enforcing the event-based constraints formulated in 1. on the spatio-temporal representation defined in 2.

In the context of a master-level internship, we will narrow the scope of this research to a small number of geological events (1.), and focus on the definition of the representation adapted to these events (2.). If successful, the internship could be pursued as a Ph.D. to explore all three sub-goals in depth.

**Principales activités**

The candidate will be expected to conduct research activities: literature review, experimentation and development of a prototype, writing a report or a paper about the research and presenting the project.

**Compétences**

Candidates should have strong programming and mathematical skills with knowledge in geometric modeling, computer graphics, and experience in Python data science libraries.

**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 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
- Contribution to mutual insurance (subject to conditions)

**Rémunération**

According by the legislation in force

**Informations générales**

- **Thème/Domaine**: Interaction et visualisation
- **Ingénierie logicielle** (BAP E)
- **Ville**: Sophia Antipolis
- **Centre Inria**: Centre Inria d'Université Côte d'Azur
- **Date de prise de fonction souhaitée**: 2024-02-01
- **Durée de contrat**: 6 mois
- **Date limite pour postuler**: 2024-01-31

**Contacts**

- **Équipe Inria**: GRAPHDECO
- **Recruteur**: Cordonnier Guillaume / guillaume.cordonnier@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.

**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.