Offre n°2024-07396

PhD Position F/M Automated medical image segmentation

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 Inria Grenoble research center groups together almost 600 people in 23 research teams and 7 research support departments.

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

Inria Grenoble 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

Inria, a French research institute dedicated to digital sciences, employs 2,600 people from the best universities in the world, and takes up the challenges of computer science and mathematics. Inria has 9 centers in France, including the Inria Grenoble research center, which employs nearly 730 people. Inria is organized into "project teams" which bring together researchers with complementary skills around a focused scientific project.

The ANR Inora project in collaboration between Inria Grenoble, the Mines de St Etienne and the University Hospital of St Etienne aims to understand the mechanisms of pain in the foot of patients with rheumatoid arthritis. In particular, the project seeks to highlight the links between certain physical factors such as forces or areas of internal and external pressure on the foot with the sensation of pain.

Mission confiée

To carry out this task, a finite element modeling method [1] of the foot is implemented by our partners at the Mines de St Étienne. Finite element methods require very fine 3D geometric models of the musculoskeletal system to produce realistic results. It is planned to acquire CT and/or MRI scanners of the foot to construct such models.

If these medical imaging methods show a good contrast between the bones and the soft tissues, certain zones nevertheless remain ambiguous for various reasons such as losses of bone density or, conversely, welds between distinct bones.
The candidate will therefore work towards a fully automated segmentation method for foot scanners which makes it possible to segment and identify each bone, i.e. to extract the surfaces of each bone in the form of mesh from a dense and regular grid of voxels, then assign a name to each element.

To reach this purpose, the problem will be tackled simultaneously at two levels:

1. Local level segmentation, based on a Convolutional Neural Networks (CNN) at voxel level [2] or Transformer architectures [3]. This will provide a local inference about the tissue. Given the very close proximity of the foot bones, particularly in the case of RA patients, this method alone might lead to inconsistent segmentations.
2. Global level segmentation: a global foot shape prior will be modelled using CNN in order to infer a coherent 3D structure from the local segmentation.

Significant effort will go towards avoiding bias to the training models at both levels. Studies on how Fundamental Segmentation Models [4,5] can be leveraged to improve the performance will be conducted.

[1] J. Tak-Man Cheung, M. Zhang, A. Kam-Lun Leung, Y.-B. Fan. (2005) Three-Dimensional Finite Element Analysis of the Foot during Standing – a Material Sensitivity Study. Journal of Biomechanics, 38(5): 1045–1054.

[2] N. Masuzawa, Y. Kitamura, K. Nakamura, S. Iizuka, E. Simo-Serra. (2020) Automatic segmentation, localization, and identification of vertebrae in 3D CT images using cascaded convolutional neural networks. In MICCAI.

[3] Hatamizadeh, Ali, Yucheng Tang, Vishwesh Nath, Dong Yang, Andriy Myronenko, Bennett Landman, Holger R. Roth, and Daguang Xu. "Unetr: Transformers for 3d medical image segmentation." In Proceedings of the IEEE/CVF winter conference on applications of computer vision, pp. 574-584. 2022.

[4] Ma, Jun, Yuting He, Feifei Li, Lin Han, Chenyu You, and Bo Wang. "Segment anything in medical images." *Nature Communications* 15, no. 1 (2024): 654.

[5] Wasserthal, Jakob, Hanns-Christian Breit, Manfred T. Meyer, Maurice Pradella, Daniel Hinck, Alexander W. Sauter, Tobias Heye et al. "Totalsegmentator: Robust segmentation of 104 anatomic structures in ct images." *Radiology: Artificial Intelligence* 5, no. 5 (2023).

Principales activités

The PhD candidate will perform some hands-on experiments, develop novel software, and write high-impact publications.

Compétences

The PhD candidate should hold a master's degree in computer science. Very good background in computer vision, 3D modelling, or medical imaging are expected. The candidate will be co-supervised by Sergi Pujades and Julien Pansiot at Inria Grenoble, France.

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
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage under conditions

Rémunération

1st and 2nd year: 2 100 euros gross salary /month

3rd year: 2 190 euros gross salary / month

Informations générales

- **Thème/Domaine :** Vision, perception et interprétation multimedia
  Calcul Scientifique (BAP E)
- **Ville :** Montbonnot
- **Centre Inria :** Centre Inria de l'Université Grenoble Alpes
- **Date de prise de fonction souhaitée :** 2024-09-01
- **Durée de contrat :** 3 ans
- **Date limite pour postuler :** 2024-05-31

Contacts

- **Équipe Inria :** MORPHEO
- **Directeur de thèse :**
  Pansiot Julien / julien.pansiot@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

Applications must be submitted online on the Inria website.

Processing of applications sent by other channels is not guaranteed.

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.