Offre n°2025-08945

PhD Position F/M Modeling the dynamic behavior of implants used in total hip arthroplasty

Type de contrat : Fixed-term contract

Niveau de diplôme exigé : Graduate degree or equivalent

Fonction : PhD Position

A propos du centre ou de la direction fonctionnelle

The Inria centre at Université Côte d'Azur includes 42 research teams and 9 support services. The centre's staff (about 500 people) is made up of scientists of di?erent 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 funding of this PhD thesis is granted by the ANR project “MoDyBe” (Modeling the Dynamic Behavior of implants used in total hip arthroplasty), which also involves the Multiscale modeling and simulation laboratory (CNRS, Paris-Est Créteil University), together with clinical partners from the department of orthopaedic (Henri Mondor hospital).

Mission confiée

Description of the project:

Cementless implants are increasingly used in clinical practice. They are inserted in the host bone using impacts performed with an orthopaedic hammer (press-fit procedure). However, the rate of revision surgery is still high, which is a public

health issue of major importance.
The press-fit phenomenon occurring at implant insertion induces biomechanical effects in the bone tissues, which should ensure implant primary stability (that is, the stability of the implant during the surgery). Despite a routine clinical use, implant failures, which may have dramatic consequences, still occur and are difficult to anticipate.
Just after surgery, the implant fixation relies on the pre-stressed state of bone tissue around the implant. In order to avoid aseptic loosening, a compromise must be found by the surgeon. On the one hand, sufficient primary stability can be ensured by minimizing micromotion at the bone-implant interface in order to promote osteointegration phenomena. On the other hand, excessive stresses in bone tissue around the implant must be avoided, as they may lead to bone necrosis or fractures.
This raises the following mathematical issues:
– What is the appropriate mechanical model of the implant insertion process into the bone?
– What are the suitable high-performance computing methods to accurately solve the above modelling equations for the bone-implant interaction subject to dynamic excitations?
– Which robust inversion approaches can be employed to retrieve the quantities of interest of the bone-implant interaction such as the bone-implant contact area?
During the PhD thesis, after a bibliographical review, the successful candidate will investigate possible dynamic models described by partial differential equations and their possible simplifications. Inversion aspects of the problem will be considered such as reconstruction of the material (bone) parameters and estimation of the stability characteristics of the implant. Anticipating the need for real-time performance, reduced order modelling aspects should be studied.

Principales activités

Research, transfer.

Compétences

Required skills:

General interest in applied mathematics and modelling in physics or life sciences, theoretical and practical experience with numerical methods for partial differential equations. Experience in continuum modelling, solution of inverse problems and model-order reduction techniques would be highly appreciated.

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 (after 6 months of employment) 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

Duration: 36 months
Location: Sophia Antipolis, France
Gross Salary per month: 2200€ (2025) 2300€ (2026)

Informations générales

- **Thème/Domaine :** Optimization and control of dynamic systems
  Scientific computing (BAP E)
- **Ville :** Sophia Antipolis
- **Centre Inria :** Centre Inria d'Université Côte d'Azur
- **Date de prise de fonction souhaitée :** 2025-10-01
- **Durée de contrat :** 3 years
- **Date limite pour postuler :** 2025-08-31

Contacts

- **Équipe Inria :** FACTAS
- **Directeur de thèse :**
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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'e?orce 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. Collecting applications 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.