2019-01568 - Post-Doctoral Research Visit F/M Cosserat catheter Model with Implicit Colliding Surfaces (CoMICS) [S]

Niveau de diplôme exigé : Thèse ou équivalent
Fonction : Post-Doctorant

Contexte et atouts du poste

Team

Contacts
Erwan Kerrien (erwan.kerrien@inria.fr) and Pierre-Frederic Villard (pierrefrederic.villard@inria.fr).

Mission confiée

Application and Scientific Context
Interventional radiology is a minimally invasive surgical technique based on the use of a catheter: a thin (diameter ranging from less than one millimeter to a few millimeters at most), long (more than one meter long) and flexible tube. Inserted into the femoral artery by a simple groin puncture, the catheter is manipulated to navigate through the blood network to the pathology (brain, heart, liver, kidney...). An access path is thus established through which other surgical micro-tools are routed to perform the treatment. The interventional radiologist must guide the catheter tip only by translational and rotational movements applied to its insertion base, approximately one meter away from the tip. The practitioner must therefore play with complex physical behaviors such as the torsion and the elasticity of the catheter, as well as the catheter reaction to the contact it may have with the arterial wall.

Learning, performing and mastering this difficult technique would benefit from high fidelity simulation capabilities. Several models have been investigated to model the catheter (mass springs, beam FEM, Cosserat model), but these solutions still have a hard time reproducing the catheter behavior. The current project aims at designing a new simulation framework able to tackle the complex boundary conditions in actual patient vasculature, at interactive rates. This framework will combine and leverage the respective properties of a Cosserat model for the catheter [1] with an implicit representation for the blood vessel surface [2].

Project description
This project has four modules. A first module will aim to study and implement in C++ the model we have already developed in Matlab. A second module will aim to improve our implicit reconstruction algorithm of the vascular surface from patient data. The third module will develop a collision and friction management method. It will exploit the properties of implicit surfaces to integrate them continuously along the curve, in order to formulate mechanical stresses both efficiently and mathematically accurately. Finally, a fourth module will cover the tasks of evaluation and validation of the model developed. The recruited person will be involved in the first two modules and responsible for the latter two.

References

Principales activités
The recruited person will pursue research activities on computer models of 1D mechanical structures. A particular focus will be put on contact management: exact force computation and application, response (e.g. deformation) of contact surface, self-contact. The proposed solutions will rely on the basis of Solid Mechanics but will harvest the field of Computer Graphics to efficiently leverage implicit surfaces. A second focus will be placed on validation, and the evaluation of the physical accuracy of the proposed simulation framework. In that context, we've been collaborating for many years with physicians at the local University Hospital.

Compétences
Technical skills and level required: PhD in computer science or applied mathematics; solid knowledge in computer graphics; good to excellent level in C++ programming; knowledge in solid mechanics as well as skills in computer vision and experience in designing and carrying out experimentations will be appreciated.
Languages: French or English
Relational skills: readiness to work in a team, in a multicultural environment; ease in communicating research work; eagerness to convey new research ideas
Avantages

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- French courses

Rémunération

Salary: 2653€ gross/month

Informations générales

- **Thème/Domaine** : Vision, perception et interprétation multimedia
  Calcul Scientifique (BAP E)
- **Ville** : Villers-lès-Nancy
- **Centre Inria** : CRI Nancy - Grand Est
- **Date de prise de fonction souhaitée** : 2019-10-01
- **Durée de contrat** : 1 an, 4 mois
- **Date limite pour postuler** : 2019-06-06

Contacts

- **Equipe Inria** : MAGRIT
- **Recruteur** :
  Kerrien Erwan / erwan.kerrien@inria.fr

A propos d'Inria

Inria, l'institut national de recherche dédié aux sciences du numérique, promeut l'excellence scientifique et le transfert pour avoir le plus grand impact. Il emploie 2400 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3000 scientifiques pour relever les défis des sciences informatiques et mathématiques, souvent à l'interface d'autres disciplines. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 160 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

**Application deadline**

June 6th, 2018 (Midnight Paris time)

**How to apply**

Upload your file on jobs.inria.fr in a single pdf or zip file, and send it as well by email to erwan.kerrien@inria.fr. Your file should contain the following documents:

CV including a description of your research activities (2 pages max) and a short description of what you consider to be your best contributions and why (1 page max and 3 contributions max); the contributions could be theoretical or practical. Web links to the contributions should be provided. Include also a brief description of your scientific and career projects, and your scientific positioning regarding the proposed subject.

The report(s) from your PhD external reviewer(s), if applicable.

If you haven't defended yet, the list of expected members of your PhD committee (if known) and the expected date of defense (the defense, not the manuscript submission).

In addition, at least one recommendation letter from your PhD advisor should be sent directly by their author(s) to erwan.kerrien@inria.fr.

Applications are to be sent as soon as possible.

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.

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.