2018-00678 - Postdoc Position / CoMICS (Cosserat catheter Model with Implicit Colliding Surfaces) [5]

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

Contexte et atouts du poste

Team

Contacts
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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 sociaux
- 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
- Ville: Villers-lès-Nancy
- Centre Inria: CRI Nancy - Grand Est
- Date de prise de fonction souhaitée: 2018-11-01
- Durée de contrat: 1 an, 4 mois
- Date limite pour postuler: 2018-09-30

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

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L'essentiel pour réussir

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.

Conditions pour postuler

Sécurité défense:
This post is susceptible to be affected in a zone à régime restrictif (ZRR), as defined in the decree n°2011-1425 relating to the protection of the potential scientific and technical of the nation (PPST). The authorization of access to a zone is delivered by the establishment's chief, after a ministerial favorable opinion, which is defined in the decree of 03 July 2012, relating to the PPST. An unfavorable ministerial decision for a post affected in a ZRR would have as consequence the annulment of the recruitment.

Politique de recrutement:
In the framework of its diversity policy, all Inria posts are accessible to people in a situation of 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.