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

Level of qualifications required: PhD or equivalent
Fonction: Post-Doctoral Research Visit

Context

Team

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

Assignment

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

General Information

- Theme/Domain: Vision, perception and multimedia interpretation
- Town/city: Villers-lès-Nancy
- Inria Center: CRI Nancy - Grand Est
- Starting date: 2018-11-01
- Duration of contract: 1 year, 4 months
- Deadline to apply: 2018-06-06

Contacts

- Inria Team: MAGRIT
- Recruiter: Kerrien Erwan / erwan.kerrien@inria.fr

The keys to success

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
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


Main activities

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.

Skills

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

Benefits package

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

Remuneration

Salary: 2653€ gross/month