Engineer position:
Validation testbed for interventional radiology simulations

Environment

Position type:	Engineer
Laboratory:	Loria (Nancy, France) http://www.loria.fr
Research team:	Magrit (http://magrit.loria.fr)
Project principal investigator:	Erwan Kerrien (https://members.loria.fr/EKerrien)
Project duration:	1 year
Starting date:	November 2018.

How to apply?

Send your resume, motivation letter, and recommendation letters (if applicable) to Erwan Kerrien (erwan.kerrien@inria.fr)

Context

Interventional radiology is said to be minimally invasive due to its enabling to operate on a patient through just an incision with minimal, which reduces potential risks for trauma, hospital-acquired infections, as well as post-op recovery time. Flexible, long and slender devices are introduced through the incision to reach the organ to be treated. Two example devices are needles used in chemotherapy of the liver or catheters that enable navigating throughout the vascular network. Radiology (X-rays) images provide a live visual feedback to control the behavior of the device during its manipulation. A long period of training is therefore require to master this extremely difficult therapeutic gesture. The success of the intervention is often related to the interventionalist's experience and his/her capacity to plan the intervention ahead, which demands means to trustfully predict the devices behavior.

Recent advances in physics-based simulation make possible building interactive simulators where the fidelity of the mechanical behavior of the simulated devices is certified. This certification implies confronting simulations with ground truth data, collected in controlled environments. But current validation workbenches are only able to reproduce very simple situations where the device may not interact with its physical environment. Collisions are thereby out of their scope, whereas they are crucial to take into account in catheter navigation.

Missions

This project aims at conceiving, and developing a innovative workbench to validate catheter simulations, including scenarios with complex collisions. The setup will rely on a pair of high speed stereoscopic cameras to observe a catheter navigate in a vascular phantom made of transparent silicon [1].

Software will be developed in C++ and Python, targeting a Python API to allow for fast prototyping of validation scenarios, and should be released as open source.

The validation workbench will be used to study Cosserat model (as implemented in Magrit team) as well as beam finite element models (available in Sofa platform – http://sofa-framework.org).

Required Skills

Education:	Master's degree or Engineering diploma in computer science
Technical skills:	excellent level in C++ and Python programming, very good level in computer science, good experience in developing experimental physical devices (sensors and hardware).
Relational skills:	ability to work within a small team of researchers, rigor to document realized work, clarity and pedagogy to convey ideas and communicate results.

Reference

[1] M. Sanz-Lopez, J. Dequidt, E. Kerrien, C. Duriez, M-O. Berger and S. Cotin. « Testbed for assessing the accuracy of interventional radiology simulations ». ISBMS - 6th International Symposium on Biomedical Simulation, 2014.
https://hal.inria.fr/hal-01059892/file/final_paper_6p.pdf