Postdoctoral Position

Development of a Patient-Specific Numerical Model for Cardiac Surgery

Host Institution:
- Institute of Intelligent Systems and Robotics (ISIR)
  75005, Paris, France
  Sorbonne University, CNRS, Inserm

Context:

This postdoctoral position is part of the **RHU-ICELAND project**, involving several academic, hospital, and industrial partners. The objective of the project is to develop a new transfemoral mitral valve annuloplasty solution that integrates intracardiac ultrasound imaging and robotics. This approach allows intervention on a beating heart without extracorporeal circulation, offering a mitral valve repair solution for high-risk patients who are ineligible for open-heart surgery and, in the long term, for most patients requiring mitral valve repair.

Direct annuloplasty involves affixing a ring or band directly onto the mitral annulus using anchors under echocardiographic and fluoroscopic guidance. The advantage of this technique is that it constrains the shape of the mitral annulus, closely replicating surgical mitral annuloplasty. The RHU-ICELAND project focuses on two key phases: developing a numerical model of the anatomy and the robotic system used to apply staples to the mitral valve, followed by designing and evaluating the robotic system, which is validated through numerical modelling.

Scientific Objectives:

Initially, the recruited postdoc will focus on the numerical modelling of anatomical structures (veins, heart, mitral valve, etc.). Preliminary work has already been carried out to design a numerical model of the heart and mitral valve with opening and closing cycles. The aim is to enhance this model for greater realism. The model will be used for clinician training, preoperative intervention planning, and validating the geometric, kinematic, and dynamic models of the robotic system (active catheter) during navigation from the entry point (femoral vein) to the target site (facing the mitral valve). The other medium- and long-term goal is to develop a realistic and, above all, patient-specific numerical model, meaning constructing the numerical model based on the patient's preoperative images.

The recruited candidate will work closely with academic and clinical teams involved in the project, particularly when integrating the research into the final demonstrator. The postdoc will benefit from a stimulating research environment and access to clinical data provided by the project's clinical and industrial partners. They will also participate in project management (meetings, decision-making, report writing, etc.).

Host Institution:

The recruited candidate will join the Institute of Intelligent Systems and Robotics (ISIR) at Sorbonne University and CNRS (Paris). ISIR is organized into several multidisciplinary teams, including RPI-Bio. Research areas include microrobotics, drones, surgical robotics, bionic prosthetics, social robots, and various intelligent and interactive systems (physical, virtual, or mixed-reality), as well as artificial

intelligence. Applications address major societal challenges: health, the industry of the future, transportation, and personal services.

The RPI-Bio team (robotics, perception, and interaction for biomedical applications), to which the postdoc will be attached, conducts research in healthcare robotics on topics such as interactive systems for expert guidance (surgery), perception (visual and haptic), human-machine interfaces, telemedicine, and microrobotics. Recently labelled by Inserm, RPI-Bio has extensive experience in developing advanced robotic solutions for interventional medicine (orthopaedics, neurosurgery, ENT surgery, endovascular interventions, etc.).

Profile Sought:
- Expertise in robotics, mechatronics, simulation, and/or numerical modelling
- Advanced programming skills (C++, MATLAB, Python)
- Proficiency in a numerical simulation library for soft robots (e.g., SOFA) is a plus
- Enthusiasm for interdisciplinary research and a collaborative spirit

Salary:
Depends on experience.

Supervisory Team:
- **Lingxiao Xun:** lingxiao.xun@sorbonne-universite.fr
- **Brahim Tamadazte:** brahim.tamadazte@cnrs.fr

Application Package:
Please send a single PDF file containing:
- CV
- Cover letter
- Relevant scientific articles

Email the application to:

Send a single PDF file containing: a CV, a cover letter, and any scientific articles you deem relevant to the application to lingxiao.xun@sorbonne-universite.fr and brahim.tamadazte@cnrs.fr. Please include *'post-doc rhu'* in the subject line of the email.

Duration and Start Date:
12 months, renewable for an additional 12 months. **Recruitment as soon as possible.**