Examples of current research programs (non-exhaustive):

Assignment

The post-doc will be related to the current topics of the team:

- Numerical methods for fluid-structure interaction.
- Modeling of the respiratory system.
- Inverse problems in bioengineering.
- Numerical methods for cardiac electrophysiology.
- Multiscale modeling in hemodynamics.

Examples of current research programs (non-exhaustive):

1. **Inverse problems of electrocardiography.** The purpose of this research activity is the estimation of the electrical activity of the heart from electrocardiographic measurements on the body surface. We will investigate a recent approach that consists in approximating the ill-posed Cauchy problem using stabilized finite elements. This provides an estimation of the surface cardiac potential that will be then used to identify the parameters of a model of the electrical activity of the heart.

2. **Fluid-structure interaction.** The objective of this research activity is the development of efficient unfitted mesh methods for the coupling of an incompressible fluid with a thin-walled structure (the archetypal application being the simulation of heart valves). A fundamental difficulty that has to be faced is that consistency demands a careful track of the interface intersections. This is due to the unfitted nature of the (unstructured) fluid mesh that does not contain any native representation of the interface. Both the use of a pure Lagrangian and Eulerian (level-set based) descriptions of the interface in the fluid will be explored. We will also address the fundamental modeling issue of contact and friction between multiple solids immersed in the fluid.

3. **Intervention planning, design, and prediction.** Multiscale models have been developed to study blood flow in patient-specific anatomies in interaction with the entire circulation. A natural application of these models is to design medical devices, interventions, and surgical plans, for example to design an artificial connection (anastomosis) between two vessels. In collaboration with children’s hospitals and Swansea U. (UK), existing and novel designs of anastomoses will be analyzed and developed to deliver optimal outcome in pathophysiology occurring in pediatric cardiology. Research will include development of methods for parameter estimation, uncertainty quantification, and biomechanical modeling (such as development of oxygen transport models and improved description of cardiac

## Context

**REO** is a joint project-team of the Inria Research Center of Paris and the Jacques-Louis Lions Laboratory (Sorbonne Université and CNRS).

Its main objectives are:

- the modeling of blood flow in large vessels, air flow in the respiratory tract, and the cardiac electrophysiology;
- the design and the analysis of efficient and robust numerical methods for these problems;
- the development of numerical software to assist medical decisions and to contribute to the design of medical devices.

REO put a strong effort in working with real data, coming either from clinicians or industrial partners. The development of methods for the interaction of data and simulation is therefore an important aspect of the activity of the team.

REO has almost 60 former members, working in academia or industries.

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## General Information

- **Theme/Domain:** Modeling and Control for Life Sciences
- **Scientific computing (BAP E)**
- **Town/city:** Paris
- **Inria Center:** CRI de Paris
- **Starting date:** 10/1/18
- **Duration of contract:** 1 year, 4 months
- **Deadline to apply:** 3/23/18

## Contacts

- **Inria Team:** REO
- **Recruiter:** Gerbeau Jean-Frédéric / jean-frédéric.gerbeau@inria.fr

## The keys to success

Essential qualities are:

- creativity;
- solid background in applied mathematics;
- have a taste for real applications;
- do not be afraid by computer programming and practical problems typically encountered in multidisciplinary works.

## Conditions for application

**Defence Security:**
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

**Recruitment Policy:**
As part of its diversity policy, all Inria positions are accessible to people with disabilities.

**Warning:** you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.
For more details, feel free to contact Jean-Frédéric Gerbeau <jean-frederic.gerbeau@inria.fr>.

Main activities
Whatever the topics, our post-docs are expected to:

- be proactive in the development of new methodologies;
- implement numerical methods and apply them on relevant test cases;
- write articles presenting their works;
- communicate their results in conferences.

Skills
The required skills are:

- Mathematical modeling with PDEs and ODEs;
- Classical methods in scientific computing;
- Computer programming (C++, Python).

Benefits package

- Subsidised catering service
- Partially-reimbursed public transport

Remuneration

- Location: Paris 12ème
- Gross Salary per month: 2 653€ brut/mensuel

Security and defense procedure:

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