2018-00638 - Postdoc Position / Optimal control problems for fluid-structure systems [S]

**Level of qualifications required:** PhD or equivalent

**Fonction:** Post-Doctoral Research Visit

**Context**

Team


**Contacts**

Takéo Takahashi (takeo.takahashi@inria.fr)

**Assignment**

**Context**

Fluid-structure interaction systems are important in several applications: medicine (blood motion in the arteries), biology (fish swimming, bird flying, micro-organisms locomotion), civil engineering (bridge design), etc.

Their studies remain difficult and most of the mathematical results were obtained at the beginning of the century.

In the recent years, we have been interested by the stabilization of such systems around a stationary unstable state. One of the difficulties comes from the fact that the perturbations on the stationary state modify also the spatial domain of the fluid. This fact leads in particular to a complication to compare the solutions of the non-stationary solution with the stationary state. Using methods based on changes of variables, we have managed to overcome this difficulty for the theoretical study of these systems.

**Main activities**

**Project description**

We would like to consider some optimal control problems for fluid-structure systems.

First, in the case of an infinite time horizon, this corresponds to a stabilization problems. Such a control problem can be solved by the resolution of a Riccati equation. In the last years, such a method have been used for the case of fluid alone or for a fluid-beam system. We want to consider a similar approach and to develop a numerical code to stabilize numerically the fluid-structure systems composed by a viscous incompressible fluid and several rigid bodies.

In order to do this, a first task consists in understanding the method based in the case of a fluid alone. Then, in order to avoid the difficulties linked to the pressure and the incompressibility condition, we will first focus on a simplified 1d problem for the motion of a particle in a viscous fluid.

One of the important difficulties in the numerical stabilization of such a fluid-structure systems comes from the fact that the spatial domain is moving. In the 1d case, such an obstacle could be solved in a simple way and this will give us hints for the case of

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**General Information**

- **Theme/Domain:** Optimization and control of dynamic systems
  - Scientific computing (BAP E)
- **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:** SPHINX
- **Recruiter:** Takahashi Takéo / takeo.takahashi@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 takeo.takahashi@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
In a second step, we want to generalize such a result for the 2d and 3d cases. We will first focus on the cases where we can neglect the motions of the rigid bodies in order to avoid the difficulties associated to the variation of the fluid domain.

A second optimal control problem that interests us correspond a model for the fish locomotion. We would like to optimize the shape deformations of an aquatic creature in order to reach some given positions. This can be written as an optimal control problem and such a work has already be performed in the case of particular swimmers and for particular regimes (Stokes fluid, potential fluid). We want then to find some optimality conditions to compute numerically the control. One of the main difficulties comes from the fact that the corresponding control (that is the shape of the swimmer) has to satisfy several constraints.

**Bibliography**


**Skills**

**Required qualifications**

PhD in applied mathematics, theory of PDE, theory of control, finite element methods, Matlab

**Language**

French or English.

**Benefits package**

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

**Remuneration**

Salary: 2653€ gross/month