



avec le Fonds européen de développement régional (FEDER)

BioImp - Microtechnologies for innovative therapy

Engineer/Post-doctoral researcher - Development of Microrobotic Tools for Single-Cell Analysis

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| • Contract type : | Engineer or post-doctoral researcher - temporary position |
| • Duration : | 1 year - renewable |
| • Location : | Institut FEMTO-ST, Besançon, France |
| • Starting date : | September 2026 - March 2027 |
| • Contact : | bioimp.recrutement@femto-st.fr |

I Contexte

The Université Marie et Louis Pasteur and its FEMTO-ST research institute, affiliated to the CNRS, are recruiting engineers and post-doctoral students as part of the ERDF BioImp project ([link to project website](#)). This project aims to contribute to the development of technologies to the manufacture of biomedicines (medicines based on biological material). The FEMTO-ST research teams are working in particular on the development of unique methods and experimental devices for sorting and characterising single biological cells, calling on a multidisciplinary team with skills in robotics, automation, IT, microfluidics, microsystems and clean-room manufacturing.

II Job description

The production of biopharmaceuticals requires the ability to move biological cells in a controlled manner. Among the various manipulation methods, non-contact manipulation methods using force fields [5] allow interaction with biological objects without direct contact. This avoids all issues related to biological contamination, ensuring the sterility of the cells and the liquid environment in which they are cultivated.

The goal of this position is to develop a microfluidic device that enable the control of biological cell trajectories in order to facilitate the analysis of single cells. Various actuation methods are being considered, including electric fields, used both for actuation and measurement, and optical tweezers, which are also used for both actuation and measurement.

For actuation, electric fields have already been used through the phenomenon of dielectrophoresis [4] to manipulate cells within microfluidic chips. Previous work within the AS2M department [2] has demonstrated the possibility of precisely controlling the trajectory of objects in two dimensions using dielectrophoresis with closed-loop control based on visual feedback. However, vision-based measurement has limitations in terms of field of view, data acquisition speed, and information processing. We are therefore interested in replacing vision with impedance spectroscopy [3]. Preliminary work [1] has validated this principle as a measurement method.

With regard to optical tweezers, proof-of-concept studies exist for measuring interactions between lymphocytes and tumor cells. However, measurable forces remain limited to a few hundred pN. Here again, we are interested in using impedance measurements to characterize cellular interactions.

The development of microrobotic devices for controlling the trajectory of biological cells using electric fields or optical tweezers represents both a technical and scientific challenge that would enable the study of cellular interactions and improve the productivity and accessibility of innovative therapeutic drugs.

III Expectation

In the context of this position, you will be required to conduct both theoretical studies (for modeling various physical phenomena and performing simulation studies) as well as experimental studies requiring the design and development of electrical and mechanical systems, the implementation of control algorithms, and data analysis. You will also need to handle biological objects and work in a cleanroom environment, but no prior training is required in these areas. You will be part of a team of engineers, post-docs, PhD students, researchers, and faculty members with complementary expertise on which you can rely.

IV Required skills

We're looking for someone with a master's degree, engineering diploma or PhD in robotics, automation, physics or microfluidics.

The following skills are not mandatory but would be an asset for the candidate:

- Knowledge of biology
- Knowledge of electrostatics and a good understanding of Maxwell's equations
- Knowledge of optics
- Modeling and control of non-linear systems
- Experience in microfluidics

V Work environment

V.1 The BioImp project and its consortium ([link to the project website](#)) :

- Project dates: 01/2024 to 07/2028
- Funding: €20 million project, co-financed by the European Regional Development Fund (ERDF) for €17.8 million
- Project partners: a multidisciplinary consortium made up of academic and industrial focus in health and microtechnology innovations (EFS, CellQuest, RD Biotech, Diaclone, Med'Inn'Pharma, the RIGHT and FEMTO-ST laboratories at the Université Marie et Louis Pasteur and FC'innov).
- The project team dedicated to the proposed offer: the person recruited will be supervised on a day-to-day basis by 1 or 2 researchers / teacher-researchers, and will be integrated into a project team made up of 5 researchers / teacher-researchers, and around 7 engineers / post-doctoral students directly attached to the project.

V.2 The FEMTO-ST Institute, a multidisciplinary environment internationally recognised for its research in science and technology

FEMTO-ST is a joint research unit associated with the CNRS ([link to the FEMTO-ST Institute website](#)). One of the largest science and technology laboratories in France (750 staff). Access to a wide range of scientific skills (the research institute has 7 departments conducting research in optics, mechanics, energy, microsystems, time-frequency, computing and robotics). Access to unique facilities:

- The technology centre dedicated to clean-room microfabrication, MIMENTO ([link to MIMENTO website](#)), is managed by a technical team of around fifteen engineers and technicians. It has a total area of around 1,300 m², including 865 m² of cleanroom space (ISO class 5 to 7). It is a member of the Renatech network, which brings together the 5 largest technology research centres. The microdevices used in the project will be manufactured in this technology centre.
- The "Centre de Micro et Nano Robotique" (CMNR) offers unique access to manipulation and characterisation facilities for small-scale fabrication, assembly and characterisation ([link to CMNR website](#)). In particular, the fluid chip micromanipulation station will enable all the experimental developments required for the project to be carried out.

Internationally recognised expertise in microrobotics and small-scale manipulation and characterisation (AS2M department)

V.3 Besançon, a small town with the advantages of a big city

- A young and dynamic population (200,000 inhabitants, 30,000 students)
- International city, home of the CLA, reference in teaching french to foreigners ([link to CLA website](#))
- A very pleasant living environment, Besançon is the greenest town in France (200m² of green space per inhabitant, nature accessible in less than 15 minutes).
- A quiet town with moderate rents, at the gateway to the Jura mountains
- City close to major cities: 2 hours from Paris by TGV, 1 hour from Dijon by train, 2 hours from Lausanne
- A town of art and history (citadel listed as a UNESCO World Heritage Site), which hosts numerous shows and festivals.

References

- [1] HONRADO, Carlos ; BISEGNA, Paolo ; SWAMI, Nathan S. ; CASELLI, Federica: Single-Cell Microfluidic Impedance Cytometry: From Raw Signals to Cell Phenotypes Using Data Analytics. In: *Lab on a Chip* 21, Nr. 1, 22–54. <https://pubs.rsc.org/en/content/articlehtml/2011/0n/d01c00840k>
- [2] LEFEVRE, Alexis ; GAUTHIER, Michaël ; BOURGEOIS, Pauline ; FRELET-BARRAND, Annie ; BOLOPION, Aude: Automatic Trajectory Control of Single Cells Using Dielectrophoresis Based on Visual Feedback. In: *Lab on a Chip* 23, Nr. 16, 3683–3693. <http://dx.doi.org/10.1039/D3LC00318C>. – DOI 10.1039/D3LC00318C. – ISSN 1473–0189
- [3] LEI, Kin F. ; HO, Yu-Chen ; HUANG, Chia-Hao ; HUANG, Chun-Hao ; PAI, Ping C.: Characterization of Stem Cell-like Property in Cancer Cells Based on Single-Cell Impedance Measurement in a Microfluidic Platform. In: *Talanta* 229, 122259. <http://dx.doi.org/10.1016/j.talanta.2021.122259>. – DOI 10.1016/j.talanta.2021.122259. – ISSN 0039–9140
- [4] PETHIG, Ronald: Review Article—Dielectrophoresis: Status of the Theory, Technology, and Applications. In: *Biomicrofluidics* 4, Nr. 2, 022811. <http://dx.doi.org/10.1063/1.3456626>. – DOI 10.1063/1.3456626. – ISSN 1932–1058
- [5] ZHANG, Zhuoran ; WANG, Xian ; LIU, Jun ; DAI, Changsheng ; SUN, Yu: Robotic Micromanipulation: Fundamentals and Applications. In: *Annual Review of Control, Robotics, and Autonomous Systems* 2, 181–203. <http://dx.doi.org/10.1146/annurev-control-053018-023755>. – DOI 10.1146/annurev-control-053018-023755. – ISSN 2573–5144