Postdoctoral position in microrobotics dedicated to cell analysis inside fluidic microchips controlled by dielectrophoretic fields.

Location: FEMTO-ST Institute, AS2M department, 24 rue Alain Savary, 25000 Besançon, France

The FEMTO-ST Institute is an interdisciplinary CNRS laboratory that involves 750 persons. It includes a cleanroom microfabrication facility (1300 m², of which 865 m² are ISO 5 to 7 classrooms) part of the national Renatech network. It includes also a unique microrobotic center in France part of the national Robotex network, which is a platform composed of equipment dedicated to micro and nanomanipulation (AFM, MEB, force measurement devices, a room dedicated to cell manipulation, etc).

Your mission:

The FEMTO-ST Institute is seeking a candidate for a postdoctoral position in the field of microrobotics applied to cell manipulation inside microfluidic chips. Your mission will be to lead and develop collaborative research at the frontiers of microrobotics, microfluidics, control and biology. More precisely, you will be responsible for driving the design and development of new microfluidic devices controlled by electrical signals to analyze and sort individual cells.

Main responsibilities:

Cells flowing into microfluidic chips are usually controlled by means of electric fields (dielectrophoretic effects) based on visual feedback [1,2]. In addition, the FEMTO-ST Institute has demonstrated the interest of using electric fields as sensing elements [3,4].

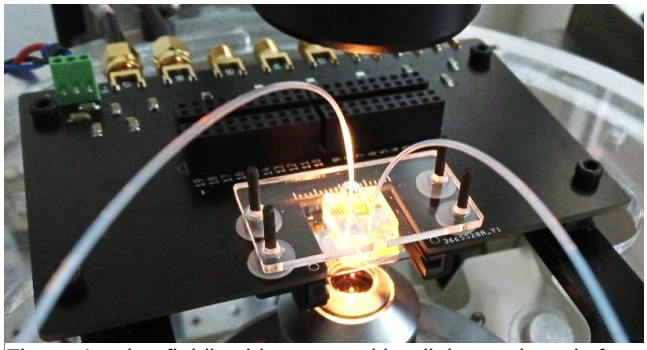

Figure 1: microfluidic chip actuated by dielectrophoretic forces - FEMTO-ST Institute

During this post doc, you will be responsible for proposing **closed-loop position control of cells within fluidic devices. The main challenge is to combine sensing and actuation relying both on electric fields (impedance tomography for sensing, dielectrophoresis for actuation).**

You will focus on

1) the design of actuating/sensing electrodes – you will work on the optimization of the size and the shape of the electrodes using either FEM modeling or more advanced methodology like topology optimization,
2) the strategies that guarantee simultaneous measurement and actuation – you will need to decouple sensing and actuation either with temporal or frequency methods,
3) the implementation of control laws – you will implement a closed loop control law based on the feedback obtained from the electric sensing unit. You will benefit from the recent development of analytical models dedicated to compute the distribution of the electric field, and the

dielectrophoretic force and torque made in FEMTO-ST [1], [2], as well as works dedicated to position measurement based on the variation of the electric fields [3], [4].

4) the experimental validation of the proposed methodologies – experiments will be conducted first on artificial objects, and then on biological cells, inside an experimental room dedicated to cell analysis in fluidic chips.

Your scientific contribution will be supported on the technical aspects by the team of engineers of the clean room of FEMTO-ST, and by the research engineers of the FEMTO-ST Institute.

You will also be responsible of all reporting and communication related to the work, and participations to international conferences will be considered if relevant. Opportunities to supervise graduate students are foreseen.

[1] V. Gauthier, A. Bolopion, and M. Gauthier, "Analytical Formulation of the Electric Field Induced by Electrode Arrays: Towards Automated Dielectrophoretic Cell Sorting," Micromachines, vol. 8, p. 253, 2017.
[2] T. Michálek, A. Bolopion, Z. Hurák, and M. Gauthier “Control-oriented model of dielectrophoresis and electrorotation for arbitrarily shaped objects.” Phys. Rev. E : Physical Review E., vol 99, n°5, 10 pages, 2019.
[3] H. Daguerre, M. Solsona, J. Cottet, M. Gauthier, P. Renaud, A. Bolopion, “Positional Dependence of Particles and Cells in Microfluidic Electrical Impedance Flow Cytometry: Origin, Challenges and Opportunities.”. Lab on a chip, vol 20, n°20, pages 3665 – 3689, 2020.
[4] B. Brazey, J. Cottet, A. Bolopion, H. Van Lintel, P. Renaud, M. Gauthier, “Impedance based real-time position sensor for Lab-On-a-Chip devices.”. Lab on a chip, 18, pages 818 – 831, 2018.

Qualification:

PhD in related fields:
- Sensing/actuation based on dielectrophoresis
- Dielectrophoretic actuation and/or control
- Microrobotics
- Physics

Note that no competence in biology is required.

Any of the following skills will be considered as an asset:
- Microfluidic
- Control

Start date: open vacancy

Salary: around 2850 € per month

Duration: one year full-time employment

Contact information: Aude BOLOPION - aude.bolopion@femto-st.fr, Abdenbi MOHAND OUSAID - abdenbi.mohand@femto-st.fr

Position open until filled. Candidates should provide a cover letter, a CV and a list of references via email to abdenbi.mohand@femto-st.fr and aude.bolopion@femto-st.fr