

# Postdoc @ FEMTO-ST: 4D Printed Soft Tethered Microrobotics

## Context

The AS2M department of FEMTO-ST Institute, specialized in microrobotics and micro-mechatronics investigate since more than 10 years on the design, modeling, fabrication, and control of microsystems and microrobots. Various systems have been achieved for micro-assembly and biomedical applications with smart actuators, sensors, and in a small volume. The needs for positioning and handling objects at the microscale are huge and cover a wide range of applications (materials, photonics, chemistry, biology), while commercially available solutions that have been designed for other purposes (for example AFM) are not well suited. Soft microrobotics is a recent and rapidly growing field of research that encompasses emerging advances in functional materials, fabrication, modelling, and performance control with important applications in the manipulation of fragile objects [1]. In 4D printing, the functionality of a soft microrobot is introduced during the printing process, especially challenging at the microscale [2]. To control this functionality, specific functional materials (for actuation and sensing) are embedded in desired locations. This project aims to develop innovative microrobot designs based on 4D printing by using two-photon lithography in order to bring high dexterity and precision nanorobotics in confined spaces.

## Objectives

The main objective of this postdoc is to design soft microrobotic architectures based on 4D printing, provide a reliable numerical model by FEM, fabricate with the support of cleanroom engineer, and characterize through dedicated experimental setup. In collaboration with polymer chemists, we want to develop soft microrobots which are fabricated by active polymers.

The postdoc starts from January 2021 and end on December 2021, the time planning of the postdoc is the following:

1. The postdoc will first have to do a solid literature review on recent advances in 4D printing using two-photon lithography with the help of the project team.
2. The postdoc will propose some designs of soft microrobotic architectures, then perform modeling by FEM.
3. The postdoc will manage the fabrication by ensuring the link between the polymer chemists and engineer of the cleanroom.
4. The postdoc will characterize and control the fabricated prototypes.

Some of the listed tasks could be done through supervision of graduate students. It is also expected that the postdoc will participate to project preparation and submission.

## Implementation and supervision team

The post-doc fellow will be a full member of the AS2M department of FEMTO-ST institute in Besançon and will closely work with Prof. Philippe Lutz, Dr. Kanty Rabenorosoa and Dr. Cédric Clévy. This work will be in collaboration with Dr. Gwenn Ulliac, and Dr. Muamer Kadic in the MN2S department, and Dr. Arnaud Spangenberg (IS2M laboratory, Mulhouse).

Micro and Nano Robotics group belongs to the AS2M department of FEMTO-ST institute (Besançon, France). The group is located in ENSMM (<https://www.ens2m.fr/>) and uses the cutting-edge infrastructure of MIMENTO<sup>1</sup> and Microrobotex<sup>2</sup>, providing centralized access to advanced microfabrication, equipment for characterization and control system facilities.

The net salary will be around 2k€ according applicant experiences. It integrates a benefit package including retirement, health insurance, annual and sick leave.

## Requirements

Applicants should have a PhD. or equivalent degree in a suitable area (e.g. microrobotics, microtechnology, mechatronics or materials science). They are expected to have strong analytical and writing skills, experience or at least a genuine interest on 3D printing technology and cleanroom micromachining. Expertise in micro/nanofabrication processes and material characterization methods will be valued. Fluency in English both written and spoken is a requirement.

## Application

Applicants are expected to send their CV and cover letter by email to Dr. Kanty Rabenorosoa [rkanty@femto-st.fr](mailto:rkanty@femto-st.fr) and Dr. Cédric Clévy [clevy@femto-st.fr](mailto:clevy@femto-st.fr). The application of the postdoctoral fellow will be closed at the middle of December 2020.

This position will be assigned to a Restricted Regime Area (ZRR), as defined in Decree No. 2011-1425 on the Protection of the Scientific and Technical Potential of the Nation (PPST). Authorization for access to an area is issued by the head of the

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<sup>1</sup> <https://platforms.femto-st.fr/centrale-technologie-mimento/>

<sup>2</sup> <https://projects.femto-st.fr/microrobotex>

institution, after favorable ministerial opinion, as defined in the order of 03 July 2012, relating to the PPST. An unfavorable ministerial opinion for a position posted in a ZRR would result in the cancellation of the recruitment.

The candidate can benefit EURAXESS services<sup>3</sup> (administrative procedures and accommodation). The EURAXESS - Researchers in motion" network (which was previously named ERA-MORE) aims to enhance careers of researchers by providing information on research careers all over Europe, individual assistance to researchers moving to another European country or returning to Europe as well as information about rights and commitments of researchers and research organisations.

## Bibliography

- [1] Zolfagharian, A., Kaynak, A., & Kouzani, A. (2020). Closed-loop 4D-printed soft robots. *Materials & Design*, 188, 108411.
- [2] Hines, L., Petersen, K., Lum, G. Z., & Sitti, M. (2017). Soft actuators for small-scale robotics. *Advanced materials*, 29(13), 1603483.

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<sup>3</sup> <http://valorisation.univ-fcomte.fr/pages/fr/menu4200/reseau-euraxess---accueil-des-chercheurs-etrangeurs/services-offers-20243-17242.html>