Centre de Nanosciences et de Nanotechnologies (C2N)
CNRS – Université Paris-Saclay, Palaiseau, France
In collaboration with LIMMS (CNRS – The University of Tokyo)

Master 1 / Master 2 internship – 2027

Development and automated control of miniature soft magnetic robots for biological manipulation

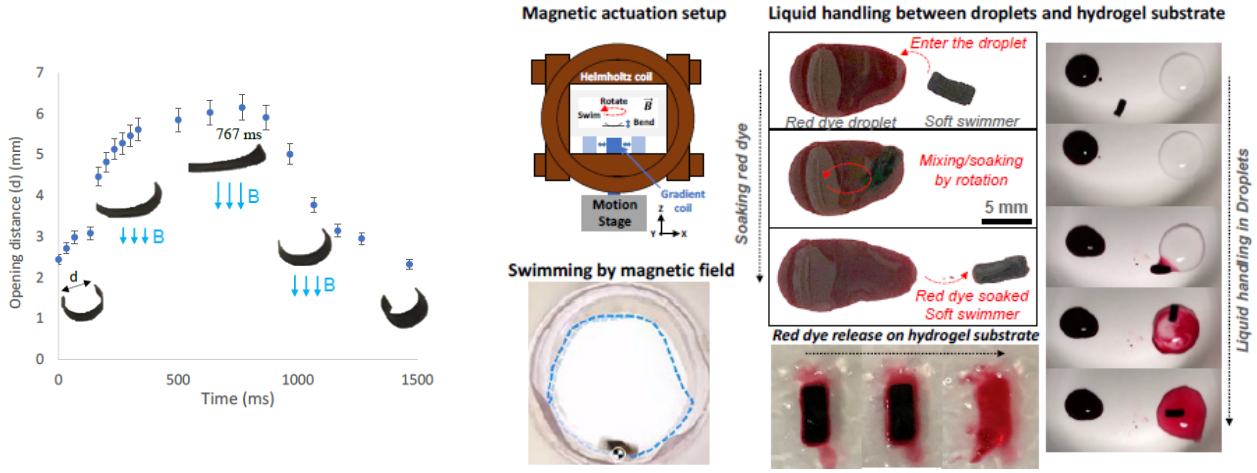
Research context

Soft magnetic robots can change their shape under external magnetic fields and adapt to different environments. In previous work with LIMMS, we developed magnetic polymer swimmers with programmable magnetization and surface microstructures, ranging from 702 µm to 5.5 mm in length. Magnetic deformation and liquid sample transfer between droplets and onto hydrogel substrates were demonstrated. These results provide a basis for developing soft robots for biological sample handling.

Internship project

The objective is to develop millimeter- and submillimeter-scale soft magnetic robots and automate their locomotion, deformation and manipulation. The student will investigate magnetic polymer microfabrication and optimize robot dimensions and mechanical properties for the intended applications. The existing manually operated magnetic actuation system will be further developed using image processing, visual tracking and feedback control.

For an M1 internship, the work may focus on fabrication, basic characterization or initial automation. For an M2 internship, it may extend to quantitative characterization, closed-loop control and automated sample handling. Potential applications include gentle manipulation of cell aggregates and organoids, solid and liquid sample handling, and integration into microfluidic systems.



Previous results: magnetic bending (left), locomotion and liquid sample handling (right), DTIP 2021.

Candidate profile and practical information

Profile: M1, M2 or engineering student in physics, materials science, micro/nanotechnology, robotics, mechatronics, control engineering or related fields. Programming or experimental experience is appreciated.
Duration: M1: 2–3 months; M2: 5–6 months. Starting date in 2027 to be agreed.
Contact: Gilgueng Hwang, CNRS researcher, gilgueng.hwang@cnrs.fr
Funding: Subject to confirmation. An M2 internship may be followed by a PhD, subject to funding availability.

Reference

G. Hwang, A. Toyokura, A. Higo, B. J. Kim and Y. Mita, “Miniaturized Soft Transformable Swimmer for Environmentally Friendly and Sustainable Fluidic Carrier,” DTIP, 2021.