



Sant'Anna
Scuola Universitaria Superiore Pisa



DOCTORAL THESIS IN BIOROBOTICS

Magnetic untethered microrobots swarms for vortex-enabled biopsy

PhD open position within the doctoral network “Soft Active Matter Microrobots for Medicine (SAM3)”, funded by EU HORIZON-MSCA-2025-DN-01-01 # 101312674

Collaboration Prof. Veronica IACOVACCI (SSSA, Pisa, Italy), Dr Loïc BLANC (Lys Medical, Charleroi, Belgium), Prof Sarthak MISRA (UT, Twente, Netherlands)

Research project on Magnetic untethered microrobots swarms for vortex-enabled biopsy (SAM3/ESR6 –magnetic untethered)

This project takes place within the Marie Curie Doctoral Network on Soft Active Matter Microrobots for Medicine (SAM3). This doctoral network of 12 PhD candidates aims at exploring the ear-nose-throat area from a microrobotics perspective. Thanks to active matter and small scale microrobotics engineering, three specific goals are targeted: (1) access the middle ear through the Eustachian tube; (2) access the olfactory clefts for mucosal biopsy; (3) access the skull cavity through the nose and the cribriform plate for cerebrospinal fluid biopsy.

This specific PhD proposal on Magnetic untethered microrobots swarms for vortex-enabled biopsy is part of the third endoscopic area namely the cerebrospinal fluid system. The goal of the PhD is the generation of tuneable fluid vortices by the magnetic actuation of swarms based on untethered microrobots to pick or release cargos: the technology could enable both biopsy (of mucus and highly viscous biological fluids) **and** drug release mediated by untethered microrobots in liquid yet hard-to-reach environments.

The expected results are further set as follows: 1) **Swarms of untethered microrobots based on magnetic matter.** 2) **Actuation strategies for generating fluidic vortices** by swarms of untethered magnetic microrobots in open and confined environments. 3) **Cargo release and pickup with controllable fluidic vortices.** 4) **Control of swarms of magnetic untethered microrobots** by fluorescence imaging.

The candidate will be enrolled as PhD student at SSSA (Pisa, Italy), in the Doctoral Degree in Robotics. A co-supervision is planned with Prof Stefano PALAGI.

An industrial stay of 4 months is planned at Lys Medical (Dr Loïc BLANC, Charleroi, Belgium) for the optical imaging of microrobots and an academic stay of 4 months at UT (Prof Sarthak MISRA, Twente, Netherlands) for the tests with magnetic and fluorescence imaging platforms.

Research environment

The main research lab will be the BioRobotics Institute of the Scuola Superiore Di Studi Universitari E Di Perfezionamento SantAnna (SSSA, Pisa, Italy).

The PhD student will be supervised by Prof. Veronica IACOVACCI (SSSA, Pisa, Italy) and co-supervised by Prof Stefano PALAGI (SSSA, Pisa, Italy).

Both supervisors of this project have complementary expertise towards the goals of this PhD: polymer design and synthesis such as programmable magnetic structures, micro-robotics and micro- and precision-engineering such as high resolution imaging and tracking at small scales.

More information on the supervisors:

- Prof Veronica IACOVACCI, Assistant Professor (Bioengineering), head of the Medical Microrobotics Lab at the BioRobotics Institute of SSSA and former MSCA global fellow (2020-2023). Her main research interest is medical microrobotics with a focus on magnetic control and tracking through medical imaging methods.
- Prof. Stefano PALAGI, Associate Professor (Bioengineering) and head of the Microscale Robotics Laboratory at the BioRobotics Institute of SSSA. His main research interest is bioinspired microrobotics as a key enabling technology for innovative applications in minimally invasive medicine.

The BioRobotics Institute department (<https://www.santannapisa.it/en/institute/biorobotics>) belongs to the Scuola Superiore Di Studi Universitari E Di Perfezionamento SantAnna. Its facilities offer fully equipped mechanical, electronic, and additive manufacturing workshops, along with advanced biological, chemical Labs and a clean room, state-of-the-art microscopy and measurement equipment.

For the implementation of the project, the candidate will move for 4 months to Lys Medical (Belgium) and 4 months to UT (Netherlands).

Job description and profile for SAM3/ESR6

We will appoint 1 PhD student on this project, related to 11 other positions open in the SAM3 EU network.

He/she will be registered within Doctoral School of Scuola Superiore Di Studi Universitari E Di Perfezionamento SantAnna with Prof. V. IACOVACCI as supervisor.

The candidate should have a master degree or diploma in biomedical or mechanical engineering, or physics, less than 5 years of career at the recruitment date and not having a doctoral degree.

We are seeking talented and enthusiastic students to perform a PhD, with a solid background in biomedical, mechanical or control engineering, or physics. Regarding skills, we look at ability for research management, dissemination, communication with colleagues and supervisors, strong teamwork spirit, creativity, problem solving and attention to safety.

The candidate should have good command of spoken and written English, and Italian, French or Dutch skills are of course an asset.

For more information regarding the PhD studies at the SSSA please check the website (<https://www.santannapisa.it/en/training/phd-programmes>).

How to apply

Applications should be sent to the mailbox SAM3@umons.ac.be dedicated only to recruitment. They should include: a) a digital copy with all academic certificates and the respective official transcription in English; b) a detailed CV and a motivation letter in English; c) 2 letters of recommendation.

Duration: 3 years full time.

Starting date: Autumn 2026

Deadline for the submission of applications: 15/7/2026 though the position will remain open until it is filled.