DOCTORAL THESIS IN BIOROBOTICS

Magnetic ultra-soft untethered microrobots for the olfactory pathway transfer

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. Stefano PALAGI (SSSA, Pisa, Italy), Dr Renato PERO (Alemnis, Thun, Switzerland), Prof Benjamin GORISSEN (KUL, Leuven, Belgium), Prof Pierre LAMBERT (ULB, Bruxelles, Belgium)

Research project on Magnetic ultra-soft untethered microrobots for the olfactory pathway transfer (SAM/ESR5 – magnetic soft)

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 cribble plate for cerebrospinal fluid biopsy.

This specific PhD proposal on Magnetic ultra-soft untethered microrobots for the olfactory pathway transfer is part of the second endoscopic area namely the olfactory clefts. The goal of the PhD is the magnetic transfer of ultra-soft untethered microrobots through complex environments like the olfactory foramina in the cribriform plate: the technology could enable the access of untethered microrobots to the brain, bypassing the blood-brain barrier, for innovative diagnostic (biopsy) and therapeutic (drug delivery) procedures.

The expected results are further set as follows: The expected results are: 1) **Ultra-soft untethered microrobots based on magnetic matter** with optimised design and preparation to enhance yield, reproducibility and compliance. 2) **Control and actuation strategies for magnetic transfer** of ultra-soft microrobots through complex environments. 3) **Demonstration of magnetic transfer of ultra-soft untethered microrobots** through phantoms of the olfactory foramina within a human cranium-like phantom: preliminary validation in plastic phantoms, final validation in cell-laden phantoms.

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 Veronica IACOVACCI.

An industrial stay of 2months is planned at Alemnis (Dr Renato PERO, Thun, Switzerland) for the mechanical characterization of microrobots, an academic stay of 6 months at KUL (Prof Benjamin GORISSEN, Leuven, Belgium) for the optimization of untethered microrobots ultra-softness by numerical methods and a second academic stay of 4 months is planned at ULB (Prof Pierre LAMBERT, Bruxelles, Belgium) for the preliminary validation with plastic phantom.

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. Stefano PALAGI (SSSA, Pisa, Italy) and co-supervised by Prof Veronica IACOVACCI (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. 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.
- 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.

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 2 months to Alemnis (Switzerland), 6 months to KUL (Belgium) and 4 months to ULB (Belgium).

Job description and profile for SAM/ESR5

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. S. PALAGI as supervisor.

The candidate should have a master's degree or diploma in biomedical engineering, material science/engineering, physics, or biotechnologies, 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 engineering, material science/engineering, physics, or biotechnologies. 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, German, Dutch or French 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.