The Scuola Superiore Sant'Anna of Pisa (Italy) issued a call for application to a Ph.D. program in the field of MICRO-BIOROBOTICS, which is in the framework of the existing Innovative Technologies of Information & Communication Engineering and Robotics International School of Doctorate.

DEADLINE for application is October 1st, 2009.

The fellowships will be funded by a grant that Scuola Superiore Sant'Anna has been awarded by the Italian Institute of Technology (www.iit.it) to foster research in MICRO-BIOROBOTICS and to specifically create a Center in Micro-Biorobotics of IIT@SSSA pursuing the following specific scientific goals within two main platforms:

1) The ROBOTIC PLATFORM: μ-Robotics development, active motion and wireless electro-magnetic positioning of miniaturized artefacts, their stimulation and control
2) The SMART MATERIALS PLATFORM: Smart, nano bio-hybrid materials for μ-Robotics

More details about the research areas covered by the MICRO-BIOROBOTICS Ph.D. programme are provided in the attached document (Micro-Biorobotics of IIT@SSSA).

Fellows will conduct research in a leading international institution and within a highly interdisciplinary environment. Interested candidates must prepare a research project relative to the MICRO-BIOROBOTICS field which will be evaluated for scientific and technical soundness and will be part of the whole evaluation process.

The fellowships, that will be awarded to the selected students, are € 14.500 per year including free meals at the Scuola Superiore Sant'Anna canteen.

The grant will fund **7 fellowships to EU candidates and 3 fellowships to non-EU candidates for a total of 10 PhD candidate three years position.**

The Scuola Superiore Sant'Anna reserves the possibility of accepting **up to a maximum of 7 EU and 3 non EU further students without fellowship** or other forms of financial support.
Interested applicants should refer to one of the following website to download instructions on how to apply.

DEADLINE for application is October 1st, 2009

Call for EU candidates:

http://www.sssup.it/context.jsp?ID_LINK=8170&area=46

Call for non EU candidates

http://www.sssup.it/context.jsp?ID_LINK=8171&area=46

For further details concerning the contents of the Ph.D. program applicants may contact:

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Micro-Biorobotics of IIT@SSSA

Micro-BioRobotics is dedicated to the study of micro- and meso-scale science and technology, and to the development of millimetric and micrometric robots. Micro- and Meso-scale robotics is defined as the science and engineering of mobile machines, with typical dimensions ranging from 1 mm down to 100 nm, exploiting micro- and meso-scale phenomena, which control the properties and performance of a wide range of different materials (including soft condensed matter, amphiphilic fluids, colloids, polymers and biological systems, such as proteins and DNA).

Micro and meso-artefacts and robots can be developed by observing, analyzing and modeling phenomena and strategies used by microscale living creatures in order to achieve motion and propulsion, and to interact efficiently and adaptively with the environment. Using advanced models, new materials and new technologies, microrobots can be designed and developed for different applications.

µ-Robotics (***Platform 1***)

The development of untethered biomedical microrobots with potential applications in targeted delivery and diagnosis, the implantation of active micro- and nano-structures for stimulation, tissue engineering and material removal are hot topics in current biomedicine. Many technologies must be developed and synergistically integrated to implement the types of biomedical applications envisioned including device design and fabrication, device localization, control and planning, power supply, biocompatibility, and surgical interfaces. All these issues become more and more intriguing when using nanostructured materials (such as carbon or boron nitride nanotubes) for remote stimulation in the nervous system.

Examples of microrobots that can be driven by external magnetic fields and that can be also tracked by MRI equipments have been recently reported. In this field, SSSA (partially supported by IIT) has already developed a centimeter endoscopic capsule with magnetic assisted locomotion. The group is studying a microscale soft-bodied robot including some vesicles of magnetic particles in a jelly body, in order to obtain a polymorphic robot, which can travel in narrow districts under controllable external magnetic fields. Among the most interesting living creatures, polymorphic mono- and multicellular organisms can be considered, which have the capability of changing their shape, continuously adapting to the external environment: some examples are given by amoebae (protists) and plankton (passive transparent organisms).

Microscale robots can be developed inspired by these kinds of natural creatures, and they can navigate in small vessels, up to the brain compartment, or along the spinal cord. In particular, for its peculiar size and features, the subarachnoid space is a lumen of the human body where no-contact navigation by a mesorobot can be very advantageous.

As regards the positioning, locomotion and control of these microrobots, hybrid solutions are being investigated, such as actuators based on living muscle cells that are fully integrated in the robot interacting with humans or inside humans, and fully controlled by means of mechatronic technologies. Muscular actuators already exist, they are

basically single heart cells coupled with flexible microstructures: they are proof-of-concepts where the controllability from the external operator is very limited. The mechanical interface between the muscular cells

and the artificial mechanisms is one of the most critical challenges, but advanced soft-lithography technologies can help in approaching these technical problems.

Smart Materials (***Platform 2***)

Smart materials can change their properties (e.g. electrical, optical, mechanical, appearance), their structure or composition, or their functions, in response to external stimuli, i.e. depending on changes of some external conditions. Their application field is not limited to biomedicine, but also to very different fields such as nanoscience and nanotechnology, biotechnology, engineering, pharmaceutical and food industries, as well communication and memory devices constructions.

Within this platform the smart materials approach is undertaken to address issues related to actuation, sensing, energy exchange, powering and in general to the integration of functions together with the miniaturization of size. For example, in living organisms, interesting and unique strategies are exploited for energy exchange and conversion, or for motion and adhesion on adverse surfaces. Such natural strategies are taken as a model in microrobotics and bio mimetism is pursued starting from the manipulation of nanostructures and nanoparticles, as well as from the micro- and nano-modification of polymers and bulk materials, and from their chemical functionalization.

Different classes of materials will be explored as building blocks for developing novel micro-robots (in strong relationship with ***Platform 1***) and in general novel smart materials. Functionalized nanofilms, nanofibers, nanoparticles are some examples of such building blocks. Nanofibers and nanowires will be used for smart materials fabrication. Their physical and electrical features can provide significant sensing and actuation potentialities, both considered as single features and integrated in smart structures.

Polymeric nanofilms are another class of potential smart materials which have a high potential of application in the field of micro-robotics. Such potential is still partially unexplored. Their very high aspect ratio, the possibility of bio-chemical functionalization, as well as the possibility to easily include functionalized nanoparticles and nanowires, make this class of materials promising for several microrobotics developments, including self assembled microstructures, actuation and sensing.