



THE INSTITUTE OF INTELLIGENT SYSTEMS AND ROBOTICS*

Joint PhD Project between *ISIR / Sorbonne Université (Paris) & Uni. di Brescia*

Subject : Microfluidic And Robotic Devices For In-Vitro Analysis, Manipulation And Injection On Biological Samples

Context: The project is on robotics manipulation, characterization and analysis of biologic samples such as isolated single cells or small animal eggs such as zebra fish. The aim is to develop a novel instrument for experimental biology to facilitate drug research using microfluidic and robotic technologies.

The proposed case study is the microinjection of a biological reagent into eggs and cells to investigate the role of certain genes and their involvement in several human diseases. Usually, microinjection is performed manually under a microscope and directly by the operator. The eggs are transferred and injected through a capillary tube. Accuracy, concentration and operator determination are essential and the procedure must be carried out quickly. As a result, the manual process often fails and its efficiency is often very low. An essential element for automation is the measurement and control of the interaction force.

Scientific objective: A first objective is the integration of a force sensor into the injector. It will be based on the principle of "position compensation": the force is not estimated by passive measurement of the deformation, but actively, by the force necessary to prevent displacement. The same device can be used for both the μN and 100mN range through purely electronic matching and control.

The second objective concerns the techniques of individual handling and mass conveyance of samples. A robotic system consisting of the microfluidic means for sample transport and the associated mechanical effectors is provided. Control diagrams covering the transfer, tele-operated or automatic handling phases will be developed, using the vision referenced control, as well as the active tools mentioned above.

The third objective concerns the human/machine interface, where an operator can intuitively control the system, act on cells in groups or isolated, program repetitive actions etc. through a touch screen display, including also real time information on the manipulation, such as chemical concentration, sample measurements and counting etc. For the injection phase, coupling and comanipulation methods will be established with force feedback to the operator, who would detect contact and penetration with a haptic interface. Its gesture will be used by the system as a reference for the automatic processing of other samples.

Required profile: Profile Master / General Engineer / Robotics / Control / EEA or Applied Physics. Previous experience in micro robotics or biology will be highly appreciated.

Required skills: Autonomous / Bilingual English / Communication

*The Institute of Intelligent Systems and Robotics (Isir) is a Joint Research Unit (UMR7222) under the supervision of [Sorbonne University](#), [The French National Centre for Scientific Research \(CNRS\)](#) and [Inserm](#) (ERL-U1150). This multidisciplinary research laboratory brings together researchers and teacher-researchers from different disciplines of Engineering and Information Sciences as well as Life Sciences.



The candidate will be jointly supervised by both labs and will obtain a double PhD from both universities. They must spend about half of time in Brescia and half of the time in Paris.

- **Thesis director** : Giovanni Legnani
- **Possible co-director** : Sinan Haliyo
- **Collaborations within the framework of the thesis**: Sorbonne University (18 months) + Uni. Brescia (18 months)
- **Duration**: 36 months
- **Location**:
 - ISIR (*Institut des Systèmes Intelligents et de Robotique*), Campus Pierre et Marie Curie, 4 place Jussieu, 75005 Paris.
 - [STIIMA](#), Università degli Studi di Brescia, Italy
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