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

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

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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 microfludic and robotic technologies.

These flexible robotic devices will be suitable for a wide range of samples and will feature automatic and remote controlled operating modes.
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, micro-injection 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. 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. 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.

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