INSTITUT DES SYSTEMES INTELLIGENTS ET DE ROBOTIQUE
JOB OFFER

Intership sheet

Subject: Out-of-plane displacement quantification for a 6DoF optical micro-robot using deep learning

Project language is ENGLISH

Supervisors: Ferhat Sadak et Sinan Haliyo

Starting date of the internship: February 2023

Duration of the internship: 4 to 6 months

Desired level of study: Master 2 or equivalent

Host laboratory: ISIR (*Institut des Systèmes Intelligents et de Robotique*), Campus Pierre et Marie Curie, 4 place Jussieu, 75005 Paris.

Contact person

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You are required to contact the supervisors BEFORE applying for the projet.

Send your application by email, with [internship subject] in the subject line, a CV and a cover letter.

Description of the internship

Abstract:
Micro-objects with dimensions ranging from 50nm to 10m can be manipulated using an optical tweezer (OT) [1]. OT can manipulate cells or other biological objects directly. Because direct manipulation of the OT can cause cell damage, it is critical to use indirect manipulation to avoid laser beam damage. The indirect manipulaton can be achieved by using the microrobot as an effector. Automation is worth developing to reduce the workload of human operators by eliminating the manual manipulation of multiple microspheres or microrobots. To that end, localization and automatic trapping of multiple microrobots in OT is required. Many existing works focus on planning and control for automated cell manipulation [5], such as using a decision theoretic based path planning approach for real-time path planning [2] and graph search-based algorithms for automated cell transport in mi- crofluidic chambers [3]. However, no attention has been paid to microrobots' real-time out-of-plane displacement estimation.This information is critical for the automation of cell handling procedures, as it will improve efficiency and control over the process. The experimental setup for a 6DoF optical robot to estimate the out-plane plane displacement is shown as Figure 1.
In overall, the aim of this project is to precisely to predict the out-of-plane displacement estimation of a 6 DoF micro robot using deep learning.

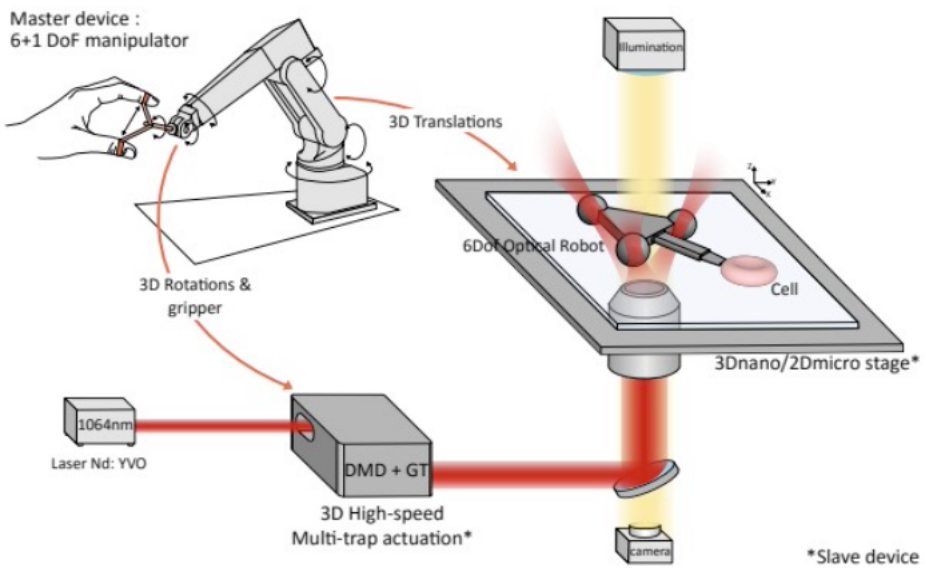

Figure 1: Optical-micromanipulation platform for dexterous single-cell handling [4].

References:

[1] Arthur Ashkin, James M Dziedzic, and T Yamane. "Optical trapping and manipulation of single cells using infrared laser beams". In: Nature 330.6150 (1987), pp. 769–771.
[2] Ashis Gopal Banerjee et al. "Real-time path planning for coordinated transport of multiple particles using optical tweezers". In: IEEE Transactions on automation science and engineering 9.4 (2012), pp. 669–678.
[3] Sagar Chowdhury et al. "Automated manipulation of biological cells using gripper formations controlled by optical tweezers". In: IEEE Transactions on Automation Science and Engineering 11.2 (2013), pp. 338–347.
[4] Edison Gerena et al. "Tele–robotic platform for dexterous optical single-cell manipulation". In: Micromachines 10.10 (2019), p. 677.
[5] Yanhua Wu et al. "Dynamics analysis and motion planning for automated cell transportation with optical tweezers". In: IEEE/ASME Transactions on mechatronics 18.2 (2012), pp. 706–713.