

Integration of imaging in a multi-well lab-on-chip system

Bachelor project assignment

Introduction

Lab-on-chip is a technology that enables biological research on small sample volume, high throughput platforms. There are many aspects in the development of the technology, one of them is to integrate mechanical actuations. In our group we have developed a multi-well platform that enables heart-on-chip research. This platform has robust control over the deformation of the samples through pressure control underneath a thin film. This system can be further improved by integrating functionalities such as electrical stimulation and imaging. This project is to integrate active imaging capabilities.

Project

The aim is to implement an on-board microscope with active focus adaptation and imaging capabilities. The difficulty is to ensure that the focus plane matches the surface of the film that is moving up and down during mechanical actuation. Several strategies can be tried to determine which one is the most feasible: (1) an open-loop adjustment of focal plane from the pressure signal; (2) a close-loop adjustment of focal plane from real-time imaging analysis for focus following; (3) a hybrid strategy that combines the two.

The student will also work on the implementation of imaging hardware and software. This has to take into account of scientific and practical needs: the system will be used in a high humidity incubator for cell culturing; it needs to be able to resolve in micrometer accuracy in a compact form; it needs to be turned on and off on demand to record time-lapse movies to characterize biological sample development; a matching light source has also to be implemented if needed. A successful completion of the project will result in a robust imaging module that can be combined with existing hardware and further enhance its capability.



Figure 1: heart on chip platform. A PDMS film is at the bottom of each well, performing sinusoidal up and down movement.

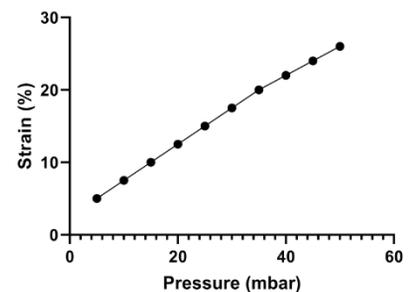


Figure 2: Strain resulting from the pressure actuation underneath the film. The focal plane needs to match the movement of the surface of the film.