MICROSCOPE-BASED ORIENTATION AND SORTING OF BIOLOGICAL OBJECTS WITH OPTICAL TWEEZERS

Benjamin Landenberger[1,2] and Alexander Rohrbach[1]

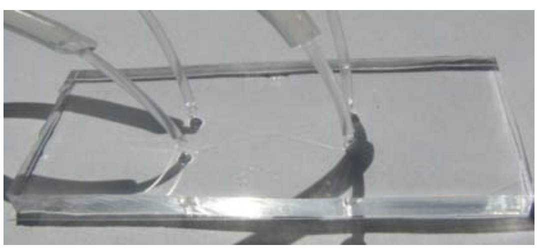
[1]Lab for Bio- and Nano-Photonics, University of Freiburg, Georges-Koehler-Allee 102, 79110 Freiburg, Germany

[2]Centre for Biological Signalling Studies (bioss), University of Freiburg, Albertstraße 19, 79104 Freiburg, Germany

E-mail: benjamin.landenberger@imtek.de, rohrbach@imtek.de

KEY WORDS: Optical trapping, particle tracking, photonic force microscopy, optical tweezers, cell sorting, holography

The relevance of biology's 3rd dimension in general and the embedding of single cells in a natural matrix of adjacent cells in particular is widely accepted in the meanwhile. Biological signalling by a cell attached to glass coverslip is different to cells as part of a cell cluster far from interfaces. So far cells clusters and organisms have often been embedded in soft gels (e.g. agarose) to prevent objects from diffusing away in liquid environments. This makes alignment procedures complicated and multi-object investigations nearly impossible. An alternative strategy to manipulate objects, i.e. to hold, shift and rotate, is to use intelligently distributed optical forces across the specimen.



A similar principle is applicable to single cells in suspension. Here, a typical demand is to determine spatio-temporal distributions of proteins inside a large number of cells. Automated cell handling and imaging can be achieved in a continuous flow in a multi-channel fluid-chamber with fast object multi-LED imaging and sorting by dynamic optical tweezers.

Our microscope setup uses an infrared laser, a spatial light modulator (SLM) and galvanometric mirrors to generate and distribute multiple optical traps across the region of interest. Even large objects like embryos can be manipulated, as long as enough optical forces are generated with sufficient high laser power. The scattered light of each trap will be imaged on a CCD camera in order to deliver position and force information of the varying anchor points across the biological specimen - even if the anchor points are outside the focal plane.