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Miniaturized Light-Sheet Microscope with active control of optical paths

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Abstract Text

Light-sheet microscopy systems are starting to become more advanced in order to revise and improve aspects such as, light-sheet uniformity, axial resolution over wider field of view, or imaging resolution and contrast [1]. Inevitably, the cost of the microscopes starts to increase, reaching levels that can be considered unaffordable for certain labs and settings. In this work, we present a miniaturized version of a LSM that aims to reduce the cost and size as well as provide active control of all the optical paths. Imaging of the whole 3D voxel takes therefore place with the sample at rest. Control of the optical paths through small-scale active optical elements are based on Microelectromechanical Systems (MEMS) technology, using a bimorph varifocal mirror, a piezoelectric 2D scanning mirror, and an electrical tunable lens (Optotune). In previous work, we have shown synchronised movement of the two optical paths in order to create a 3D image of the sample over a 200 µm depth and 500 µm x 280 um width and height [2]. In this work we introduce a custom 3D printed optical prism to reduce astigmatism in the image collection for flat bottomed sample holders. In this way we attempt to image both “thin” samples fixed on microscope slides as well as “thick” samples embedded in an agarose gel volume. We manage to achieve significant reduction of astigmatism, especially for “thick” samples whereas the imaging resultion is set to sub-micron levels.

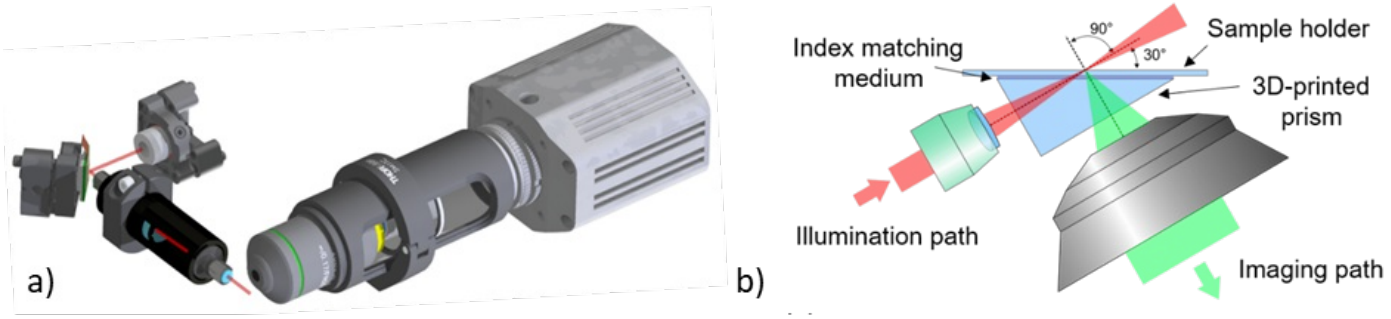

Figure 1. a) 3D schematic of the Miniaturized LSM b)Schematic of the light-path intersection and sample mounting including 3D printted prism