

EASY AND VERSATILE ADAPTIVE OPTICS ADD ON FOR HIGH RESOLUTION MICROSCOPY WITH DEFORMABLE LENS

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Images acquired with high performance optical microscopy systems can be severely affected by the presence of phase aberrations introduced by the sample, or by defects and misalignments of the optical system itself. Correction of phase aberrations has been proven possible through the use of active optical devices, such as deformable mirrors or spatial light modulators [1].

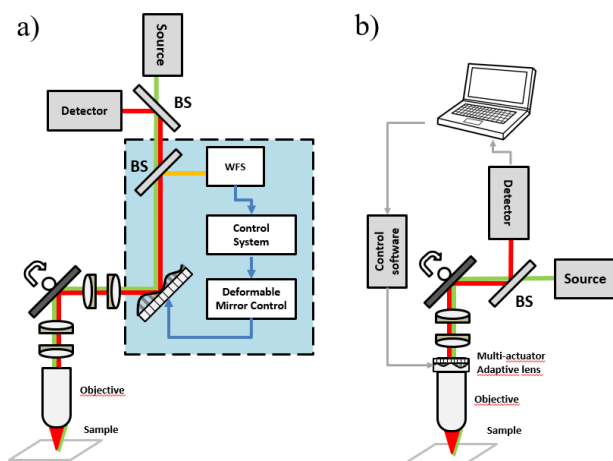


Figure 1: AO setup with reflective (a) and refractive (b) optical elements

While the results presented in literature show how implementation of adaptive optics could provide significant advantages for the end users, the complexity of implementation of adaptive optics in an existing microscopy setup prevents the widespread adoption of the technique. In particular, the implementation of adaptive optics through a reflective optical element (i.e. a deformable mirror) requires significant modification to both the hardware and software of the microscopy system (Figure 1a), which requires time and effort for a custom made setup, and is in general simply impossible in a commercial setup.

In this paper, we present a technique to easily implement adaptive optics on any optical microscopy system through the addition of a refractive adaptive element [ref. articolo lente] at the back of the microscope objective, and a standalone control software which performs wavefront optimization based on images acquired from the computer screen (Figure 1b). We prove the validity and versatility of the technique by implementing it on a variety of different microscopy systems: in particular a commercial confocal microscope, a generic epifluorescence microscope, a lightsheet microscope, and a multiphoton microscope used for in-vivo functional imaging.

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[2] S. Bonora, Y. Jian, P.i Zhang, A. Zam, E. N. Pugh, R. J. Zawadzki and M. V. Sarunic, “Wavefront correction and high-resolution in vivo OCT imaging with an objective integrated multi-actuator adaptive lens”, *Optics Express*, 23, 17 (2016).