OPTICAL ABERRATIONS OF THE MOUSE CORTEX MEASURED WITH AN EXTENDED SOURCE SHACK HARTMANN SENSOR

Sophia Imperato[1,2]*, Antoine Hubert[1,3], Thomas Pons[1], Fabrice Harms[3], Laurent Bourdieu [2], Alexandra Fragola[1]
[1]ESPCI – LPEM, 10, Rue Vauquelin, 75005 Paris, France
[2]Institut de Biologie de l'Ecole Normale Supérieure, 75005 Paris, France
[3]Imagine Optic, 18 rue Charles de Gaulle, 91400 Orsay, France

***sophia.imperato@espci.fr**

In neuroimaging, the resolution is strongly deteriorated by the refraction index inhomogeneity inherent to the sample limiting the imaging depth. Moreover, as the later increases, consequent aberrations are observed on the imaging path and affect significantly the imaging quality. To overcome this difficulty, adaptive optics has been implemented on several microscopy set ups, for in vivo imaging, and currently provides a reliable live correction of the aberrations, enabling functional recording of neuronal networks [1].

Using a new Shack-Hartmann sensor based on extended scene, we provide a study of the aberrations introduced by fixed and freshly dissected mouse brain samples, and more particularly by the cortex, the accessible zone for *in vivo* recordings of the neural network. The wavefront sensing approach used, developed for astronomy and now used for Light Sheet Fluorescence Microscopy [2], is faster and more reliable than indirect wavefront sensing and does not require any guide star.

We discuss the impact of the fluorescence wavelength on aberrations as well as the evolution of the amount of aberration with the increasing thickness of the considered brain slices, hence mimicking the imaging depth increase. We also study the variation of the isoplanetic patch with depth. These measures lead us to a better understanding of parameters driving brain aberrations, hence to an optimized targeted correction of these aberrations.

[1] Zheng, W., Wu, Y., Winter, P. *et al.* Adaptive optics improves multiphoton super-resolution imaging. *Nat Methods* **14,** 869–872 (2017). https://doi.org/10.1038/nmeth.4337

[2] Hubert, A. *et al*. Adaptive optics light-sheet microscopy based on direct wavefront sensing without any guide star. *Opt. Lett* **44**(10) 2514-2517 (2019)