# SIMULTANEOUSLY MULTIPLE TARGETS EXCITATION AND WAVEFRONT CORRECTION FOR NEUROSCIENCE

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## ABSTRACT

Optogenetics has been widely utilized in neuroscience nowadays. However, single spot excitation limits the manipulation efficiency. Besides, the wavefront distortion caused by the opaque brain tissue degrades both the depth and quality of the focus. Packer *et al.* applied spiral scanning to excite the target neurons sequentially [1]. Papagiakoumou *et al.* revealed an alternative method by applying temporal focusing with generalized phase contrast to improve excitation efficiency [2]. Yang *et al.* employed computer-generated holograms (CGH) to generate multiple spots in the sample [3]. But these works were not compatible with adaptive optics so that the focal depth was still limited to the superficial layer. Here, we present a novel strategy which can excite multiple targets simultaneously and correct the wavefront distortion with the custom designed one-photon system. By combining pupil segment methods with CGH, multiple and custom shaped speckles are generated in the sample (Fig. 1). And the modified coherent optical adaptive technique is used to optimal each speckle independently (Fig. 2).

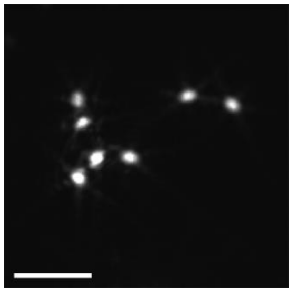

Figure 1: Seven focuses generated by pupil segment methods. Scale bar 300 um.

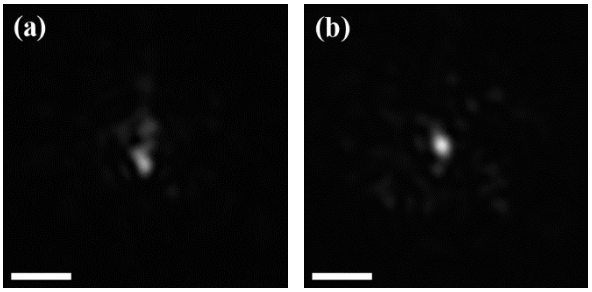


Figure 2: The focus before and after wavefront correction. (a) The distorted focus due to scattering effect introduced by a ground glass diffuser. (b) The recovered focus after wavefront correction. Scale bar 100 um.

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