WAVEFRONT CORRECTION OF DOUGHNUT BEAM BASED ON THE CONJUGATE ADAPTIVE OPTICS

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ABSTRACT

The doughnut beam is a spatially structured beam with a dark spot at the center, which has been widely applied in optical super-resolution microscopy. While when passing through scattering media, optical aberrations caused by the heterogeneities of refractive index distribution in turbid media, will deteriorate the performance of the doughnut beam. Nowadays, adaptive optics (AO) is one of the powerful tools to achieve the wavefront correction in microscopy. Thus, AO can be used for doughnut beam to image deep in the biological sample [1]. However, the corrected field of view (FOV) is generally limited in conventional pupil AO, where the correction element is placed on the conjugation plane of the objective rear pupil, and only the invariant distortion can be corrected [2]. Here, we propose the wavefront correction method in conjugate AO system for the doughnut beam based on coherent adaptive optical technique, where the correction element is located on the conjugate plane of the scattering media [3]. The aberrations varying with spatial positions can be compensated, improving the corrected FOV. Therefore, for doughnut beam, our method has the potential of imaging effectively in biological sciences. Figure 1 demonstrates the focal spots of Gaussian beam and doughnut beam with scattering or conjugate AO, which proves the ability of conjugate AO in recovering the focal spots.

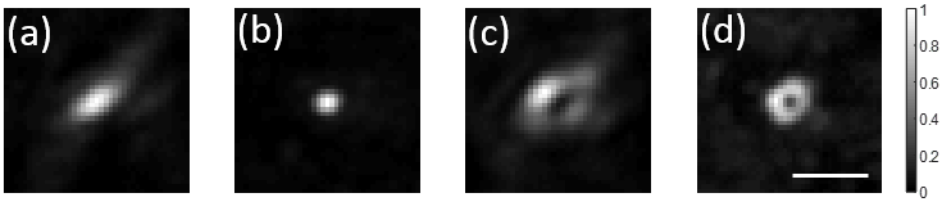

Figure 1: The focal spots (a) with scattering of Gaussian beam, (b) with conjugate AO of Gaussian beam, (c) with scattering of doughnut beam and (d) with conjugate AO of doughnut beam. The thickness of the sample is 600 μm and the scale bar is 100 μm.

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