AXIAL-PLANE HOLOGRAPHIC OPTICAL TWEEZER

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ABSTRACT: Holographic optical tweezers (HOTs) permit trapping and dynamic control of numerous particles in three dimensions (3D) in parallel, serving as powerful tools in study of particle interaction and micro/nano fabrication. However, due to the limited depth of view, conventional HOTs mainly focus on trapping of particles in a small 3D volume holding the focus. In this paper, we report a novel axial-plane HOTs, which directly manipulate particles in the axial plane (X-Z plane) instead of the lateral plane (X-Y plane). To achieve the axial-plane HOTs, we developed a new Gerchberg-Saxton iterative algorithm based on the axial-plane Fourier transform for directly creating the desired trap pattern in the axial plane with high efficiency. By combining the proposed algorithm and the axial-plane imaging technique [1, 2], we demonstrated the dynamic control of multiple 5μm silica microbeads with point-trap arrays. We achieved trapping of 10 microbeads along the axial direction with a 1×10 trap array over a distance of up to 200 μm when using an objective lens with numerical aperture of 0.95. Providing a new degree of freedom to manipulation of particles compared with the conventional HOTs, the axial-plane HOTs will find their potential applications in diverse research areas, such as micro/nano fabrication, optical binding, etc.

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