VIDEOMICROSCOPY FOR THE PARALLEL CALIBRATION OF TRANSVERSE OPTICAL FORCES IN MULTIPLE HOLOGRAPHIC OPTICAL TWEEZERS

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KEY WORDS: Holographic optical tweezers, calibration, optical force.

1. INTRODUCTION

Holographic optical tweezers are now a conventional way to define and control dynamic patterns of multiple optical traps [1]. Unfortunately, most of currently used force calibration methods for optical tweezers are only employed with a single optical trap [2]. In this work, we propose a videomicroscopy-based way to simultaneously calibrate the forces of multiple holographic optical tweezers.

2. FORCE CALIBRATION

For small movements, trapped beads behave as damped masses in parabolic energy wells, i.e. as if they were attached to the centres of the traps by a spring. As a consequence, measuring the displacements of all the beads when an external force is uniformly applied to the sample provides the stiffness of each one of the fictitious springs. Force calibration is performed by moving the microscope stage along a given direction with a controlled velocity, which gives rise on the beads to a well-defined drag force that can be quantified from Stokes' law. For small values, the drag force induces a displacement of the trapped beads from the centre of their trap that is inversely proportional to the applied optical force. The parallel measurement, by use of a videomicroscopy technique, of beads displacement allows to determine the optical forces of each optical trap of the holographic optical tweezers pattern.

We developed such a calibration method and used it to evaluate the holographic optical tweezers efficiency, with different experimental configurations. Results will be given to compare the trapping efficiency of conventional optical traps, holographic traps and Quadrant Kinoforms holographic traps [3]. For a given experimental setup, one can also estimate the uniformity and anisotropy of trapping forces over a complex two-dimensional traps distribution.

3. REFERENCES

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