NANOPARTICLE CONCENTRATION MEASUREMENTS USING FLUORESCENCE SINGLE PARTICLE TRACKING

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KEY WORDS: single particle tracking, number concentration, nanoparticles

1. INTRODUCTION AND THEORY

We present a novel framework for accurate particle number concentration measurements of monodisperse samples using single particle tracking (SPT). Consider tracking of independent particles undergoing Brownian motion in a liquid suspension. It is evident that the number of observed particle trajectories in a given time frame is proportional to the particle concentration. However, in order to convert the observed number of trajectories to an absolute concentration, the size of the detection region has to be known precisely (see figure (1)). In contrast to previous work [1], the new analysis model that we present here does not require prior calibration of the detection region. Instead, it incorporates inherent calibration of the detection region and leads to accurate estimation of the particle number concentration, independent of instrumental and image processing settings. This is achieved by using the observed distribution of trajectory lengths which is directly related to the size of the detection region.

2. EXPERIMENTAL RESULTS

SPT experiments were carried out using a custom-built laser widefield epi-fluorescence microscope with a solid state laser for illumination and an electron multiplying CCD camera. Time-lapse movies of freely diffusing 0.52 µm fluorescent polymer nanospheres of originally 1 % weight percentage were acquired. The particles were diluted into five different concentrations, roughly in the $10^8$-$10^9$ part/ml range. Concentrations were estimated using the SPT framework and compared with theoretical estimates computed from the known weight percentage and particle diameter. As can be seen from the results in figure (2), the SPT concentrations are well within the error bounds of the theoretical concentration estimates. This establishes SPT as a promising technique for accurate nanoparticle concentration measurements. This has interesting implications for using SPT to do concentration measurements in complex fluids, as well as for the analysis of particle size distributions [2].

REFERENCES