STRUCTURED ILLUMINATION MICROSCOPY WITH A 3D LATTICE FOR LIVE CELL IMAGING

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Structured Illumination is one of the most powerful and versatile methods in fluorescence microscopy providing optical sectioning and even superresolution in all three spatial dimensions [1]. In recent years, it developed into a routine method for the study of biological structures and biochemical processes [2]. However, live cell imaging of dynamic processes in living samples is still challenging. This is mainly due to the time it takes to acquire the multiple raw images which are required to reconstruct a single frame. That's why researchers often see themselves restricted to acquire time-lapse images only in 2D. An increase in temporal resolution - either to resolve fast processes, or to be able to get from 2D acquisition to volume imaging is therefore highly desirable. At the same time, fast live cell imaging suffers from the drawback of small number of photons available per single raw frame especially while keeping the illumination photon dosage low to minimize photodamage. Combined with background noise arising from out-of-focus fluorescence, this limits the raw image quality and subsequently the achievable resolution in the final image.

Here we demonstrate how a 3D Lattice structured illumination [3] allows not only imaging with a lateral optical resolution of 120 nm in all directions but also improves additionally the modulation contrast compared to classic SIM [4]. This is highly beneficial when imaging sparsely labeled living samples – and it allows very fast image acquisition.

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