TOWARD MILLISECOND VOLUMETRIC MICROSCOPY

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Fluorescence imaging of three-dimensional (3D) biological samples is normally performed by the sequential acquisition of sections from different focal planes, as in laser scanning microscopy (LSM) or light-sheet fluorescence microscopy (LSFM). Typically, the shifting of the focal plane is achieved by mechanical translation of the sample or objective, a step that requires long idle times for proper repositioning to occur. This strongly limits volumetric imaging speed, particularly evident when characterizing thick samples or the dynamics of fast evolving processes. In this talk, I will discuss our efforts to enhance 3D imaging speed in LSM and LSFM. Our strategy consists of axially scanning the focus at kHz rates using an acoustic liquid lens. Such high speed enables unprecedented z-focus control, offering novel opportunities for tailored extension of the depth of field [1, 2] and simultaneous multiplane imaging [1, 2]. It also renders possible the implementation of light-sheet microscopes that completely lack of any mechanical moving parts, capable of imaging hundreds of volumes per second [3]. I will discuss the advantages and pitfalls of this technology and illustrate them with applications, including imaging of brain tissue and flowing cells.

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