

Ultrafast and Sensitive – Confocal Imaging in BioMedical Research with the LSM 5 LIVE

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Today's biomedical applications are mainly driven by the need to understand functions and interactions of structures and molecules in living biological model systems. Such applications address the development of cells and organs, the control of protein networks in cells and cell clusters, the dynamics of intracellular organelles as well as ion signalling processes within cells and across cell membranes.

Hence, research activities focus on the investigation of various complex dynamic processes taking place at different time scales and in samples that range from living cells over intact tissues and organs to live organisms.

In order to address those questions, a microscopic imaging systems needs to fulfill 3 basic requirements: In particular, it needs to (1) provide the imaging speed to monitor fast dynamics and kinetics of cellular and subcellular structures while providing (2) the sensitivity to image weakly stained objects without causing detrimental effects by observation and (3) a high spatial (3D) resolution to monitor subcellular structures of different sizes. Today's instrumentation tends to be optimized towards 1 or 2 of these requirements only. Being subject to restrictions imposed by a typical live sample these instruments, therefore, fail to image dynamic structures and processes at satisfactory 3D resolution.

We demonstrate (1) a fast confocal fluorescence scanner with image acquisition speeds greater than 100 fps at 512 x 512 pixels², (2) which provides at least 10 fold increased sensitivity with acquisition speeds of today's top-of-the line point scanning confocal systems and (3) good optical sectioning capabilities. The system utilizes a highly efficient concept to split the emission light from the detection light.

After a short introduction into technical aspects of the instrument setup, the performance of the LSM 5 *LIVE* regarding ultrafast imaging, exceptional sensitivity, and resolution in 2D and 3D is demonstrated in several biomedical application examples.

In an optional workshop Carl Zeiss is further focussing on different aspects of advanced imaging during the course of the conference.

Keywords:

Confocal, scanning microscopy, fast dynamics, fluorescence imaging, ultrafast imaging