A DIGITAL SCANNED LASER LIGHT SHEET MICROSCOPE (DSLM)

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Single Plane Illumination Microscopy (SPIM) provides fast three-dimensional recording of fluorescent biological specimens [1]. Photobleaching and phototoxic effects are minimized since only the fluorophores in the common volume of the illumination light sheet and the focal plane of the detection lens are excited. These features (amongst many others) make SPIM valuable in studies of fast biological processes at high magnification as well as for *in vivo* experiments with very sensitive organisms [2,3].

In an effort to further improve imaging quality, acquisition speed and ease of use, we developed, built and now operate a "Digital Scanned Laser Light-Sheet Microscope" (DSLM), the next generation of light sheet based microscopes. We employ laser scanners for the generation of a light sheet in a very flexible illumination system. The re-design of the microscope allowed us to optimize the set-up with respect to the number of employed components and optical interfaces. Moreover, DSLM is a completely digitally implemented microscope with powerful custom operating software.

This approach provides a number of new capabilities: DSLM offers a homogeneous and aberration-free symmetrical light sheet profile and the adaptation of a very flexible approach to structured illumination. Therefore, the imaging quality is significantly improved for large penetration depths into the specimen. The digital concept in combination with high-precision laser scanners ensures rapid switching between different illumination modes and minimizes the time required for the alignment of the system. DSLM is particularly well-suited for high-throughput applications that require an excellent imaging quality at very high recording speeds.

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