FLEXIBLE, MODULAR SOLUTION FOR HIGH-SPEED IMAGE ACQUISITION ON A COMMERCIAL LIGHT-SHEET MICROSCOPE

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ABSTRACT: Light-Sheet microscopy is a particularly fast microscopy technique well-suited for live imaging due to its efficient use of light. Using custom-made systems and fast sCMOS cameras it has recently become possible to image at rates of several 100 frames per second in single planes, e.g. to capture dynamics of the beating zebrafish heart [1] and with more sophisticated systems to reach volume rates of 10s of volumes per second [2, 3, 4]. This level of performance is more challenging to achieve in commercial systems that need to serve a wide range of applications.

We present a simple, modular upgrade optimized for highest acquisition speeds within a commercial light-sheet microscope, the Leica TCS SP8 DLS, with minimal modifications. We use a CMOS camera (Baumer VCXU-50M) with global shutter to avoid image artifacts and overcome limitations due to synchronization issues between the shutter and the scanned illumination beam. The additional camera is synchronized with the microscope by trigger signals but controlled by a simple LabVIEW program on a separate computer to minimize interference with the standard setup.

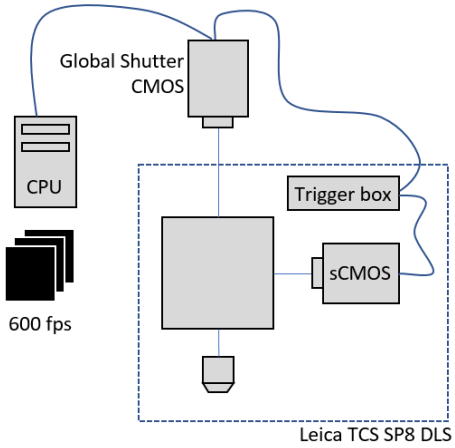

Fig.1: A CMOS Global Shutter camera is attached to the DLS to achieve up to 600 fps

We demonstrate imaging at framerates of up to 600 fps. Examples include imaging a beating zebrafish heart at speeds of 290fps for a ROI of 1024x512 px and at 540 fps for a ROI of 1024x256 px, in both cases over a duration of 2.5s, where we could verify that we have enough image quality and SNR to perform image analysis.

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