**TCSPC camera for real time video rate FLIM acquisition based on CMOS technology**

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The use of fluorescence lifetime imaging microscopy (FLIM) is appealing for the study of biomolecular interactions. Traditionally FLIM has made use of scanning techniques to image a sample with a "single-pixel" detector, while widefield approaches have mainly related to intensity-based imaging. The latter is is advantageous to study mobile samples or kinetics, usually not achievable with FLIM. Rapid fluorescence lifetime imaging is especially important in the monitoring of biological samples, eg. because of cell movement. Recent advances in CMOS technology has led to the development of imaging sensors, based on arrays of pixels, with each pixel containing a single-photon avalanche photodiode (SPAD) and its associated timing electronics, based on a time to digital converter (TDC). This enables rapid (video rate) fluorescence lifetime determination based on the time-correlated single-photon counting technique (TCSPC) to be realised independently in each pixel.

Here, we incorporate a 192 x 128 pixel image sensor[1], implemented in STMicroelectronics 40nm CMOS technology, in a widefield epifluorescence microscope set-up. The sensor exhibits a 13% fill-factor and each 18.4 x 9.2 µm pixel contains a TDC with a resolution <40ps. This enables up to 24576 parallel fluorescence lifetime measurements. By firmware and software implementation both the intensity and the average lifetime from the TCSPC imaging measurement can be simultaneously displayed in real time at video (>30 fps) rate. This capability is demonstrated using standard samples and FUN-1 labelled yeast[2].

References

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