Fast FLIM for live cell bioimaging  
towards a pixel-modulated EMCCD camera

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The fluorescence lifetime - the average decay time of the excited state fluorescence - is a quantitative signature of a fluorescent material which can be used to probe its structure and dynamics at micro- and nano scales. FLIM (Fluorescence Lifetime Imaging Microscopy) is used as a routine technique in cell biology to map the lifetime within living cells, tissues and whole organisms. The fluorescence lifetime is affected by a range of biophysical phenomena, and hence the applications of FLIM are many: from ion imaging and oxygen imaging to studying cell function and cell disease in quantitative cell-biology using FRET.

In an IOP Photonic Devices project a consortium consisting of TU Delft, Teledyne DALSA, NKI and Lambert Instruments, is developing a lifetime imaging camera with EMCCD image sensor that can be modulated at high frequencies at the pixel level. The modulated EMCCD camera represents an entirely new class of full-field fluorescence lifetime imaging systems. By developing a sensitive, directly modulated EMCCD camera, the aim is to improve upon fluorescence lifetime accuracy, low light level sensitivity, spatial resolution, ease-of-use and robustness. This talk includes a summary of published results of a first version of the camera, and an outlook towards the possibilities of the new version of the EMCCD camera which is currently under development.