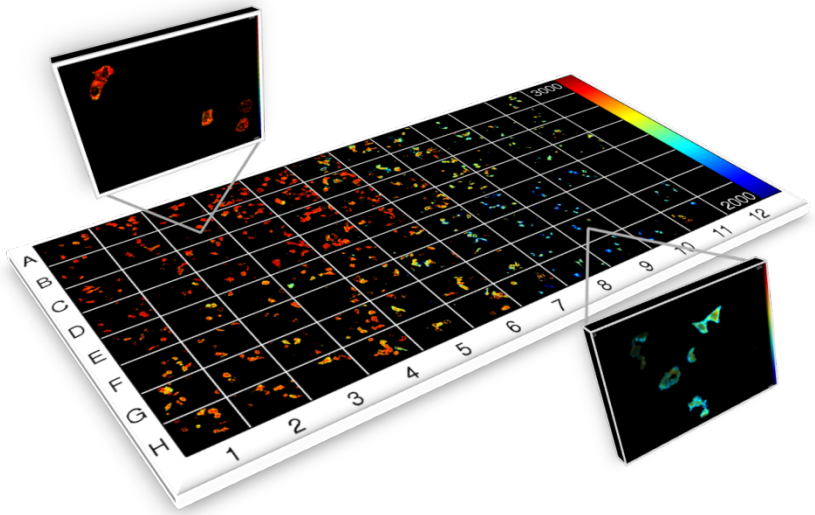
Fluorescence lifetime imaging across the scales

Prof Paul French, Photonics Group,

Department of Physics, Imperial College London

Longer abstract

This talk will review our development and application of fluorescence lifetime imaging (FLIM) and metrology technology applied to microscopy, high content analysis (HCA), endoscopy and tomography, emphasizing the potential to translate molecular readouts across the scales. For cell biology we have developed FLIM microscopes including high-speed optically sectioned FLIM for rapid 3-D imaging, including of FLIM FRET readouts in live cells. For drug discovery we have this to automated optically sectioned FLIM/FRET multiwell plate readers that can "read" a 96 well plate in less than ~15 minutes. With its associated analysis software, this technology makes FLIM a practical tool for HCA including for live cell assays. For drug discovery and for fundamental biomedical research, it is of increasing interest to translate cell-based assays to in vivo studies. Accordingly, we are developing tomographic FLIM instruments including FLIM optical projection tomography, which we have applied to live zebrafish embryos and diffuse FLIM tomography, with which we have demonstrated in vivo FLIM FRET in a mouse model. For imaging larger disease models and patients, we are developing a range of FLIM endoscopes including a FLIM confocal endomicroscope, wide-field FLIM endoscopes and single point fibre-optic multidimensional fluorescence probes to provide more detailed information on complex spectro-temporal autofluorescence signals. These endoscopic instruments are complemented by clinical multiphoton multispectral FLIM tomography, from which we have obtained in vivo data.



Fluorescence lifetime images acquired on an automated multiwell plate reader – from D. Alibhai et al., Automated fluorescence lifetime imaging plate reader and its application to Förster resonant energy transfer readout of Gag protein aggregation, J. Biophotonics 6(5), 398-408 (2013). The DOI is 10.1002/jbio.201200185 (http://onlinelibrary.wiley.com/doi/10.1002/jbio.201200185/abstract)