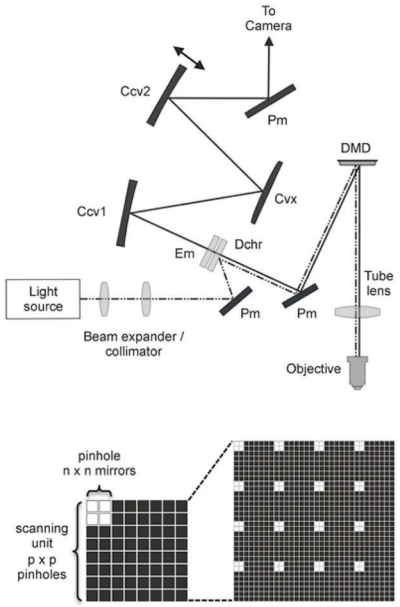
UNIVERSITY OF LEICESTER

Fast, digital confocal microscope module

- Economical
- Rapid
- Super-resolution



Schematic diagrams of the DMD confocal optical pathway

Challenge

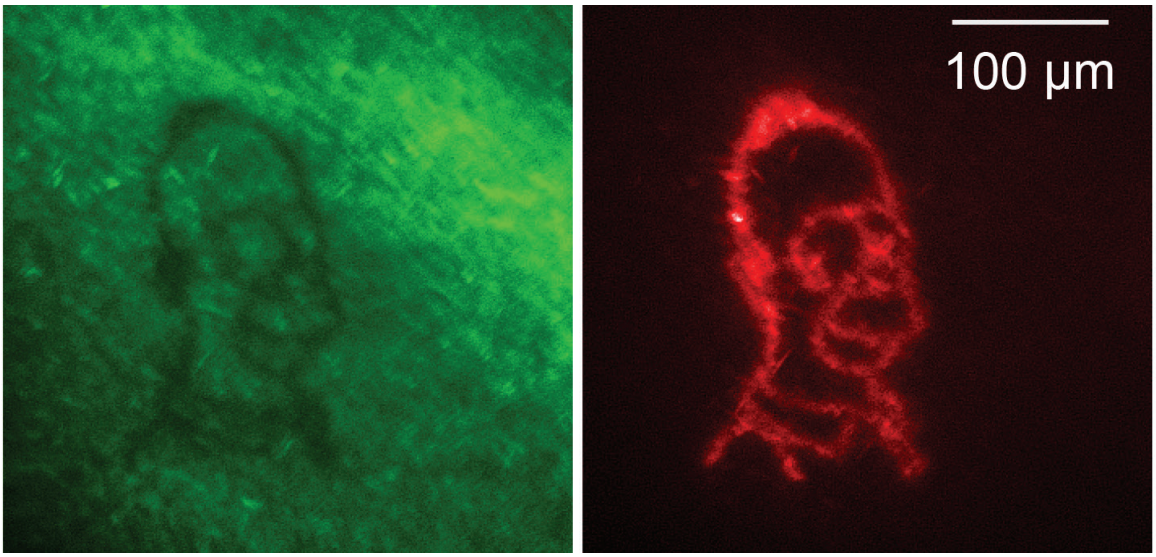
Confocal fluorescence microscopy is widely used to obtain high-resolution images of biological specimens; however, the speed of most standard commercial instruments is insufficient to resolve the temporal dynamics of many cellular events.

The high purchase price and expensive service charges of multi-laser confocal microscopes prohibits their use in many laboratories.

Solution

A new digital microscope has been developed at the University of Leicester, that is:

- **Economical:** A confocal module has been developed which can be added on to a standard fluorescent imaging system to produce a high speed, multi-wavelength confocal microscope. The system is entirely digital, has no chromatic aberration and uses low cost LEDs instead of lasers.
- **Rapid:** It collects images at speeds up to 100 times faster than a standard scanning microscope and delivers an equivalent image resolution.
- **Versatile:** The degree of confocal sectioning can be freely adjusted through software between widefield and maximum confocal sectioning to provide video rate images at high spatial resolution. The system allows programmable illumination for photoactivation.
- **Super-resolution:** Structured illumination combined with a patented software analysis process allows collection of super-resolution images with a > 2 fold improvement in lateral and axial resolution.



Advanced control over illumination patterns

Benefits

- **Video rate images (≥ 50 fps) at high spatial resolution:** The DMD functions as a solid state, digital Nipkow disk, but with freely programmable control of the pinhole size and separation. The degree of confocality can be freely adjusted from widefield to maximal confocal sectioning.
- **Potential for significant cost savings:** A confocal module has been developed which can be added onto a standard fluorescent imaging system to produce a high speed, multi-wavelength confocal microscope. The system is entirely digital, has no chromatic aberration and uses low cost LEDs instead of lasers.
- **Increased reliability and reduced maintenance costs:** The elimination of lasers and absence of a physically moving scanner increases reliability and reduces maintenance costs.
- **Advanced illumination patterning:** Free control of the illumination pattern, light intensity and wavelength means that the system can be used for applications such as fluorescence recovery after photobleaching, photoactivation and optogenetics (Image above).
- **Structured illumination** combined with a patented software analysis process allows collection of super-resolution images with a > 2 fold improvement in lateral and axial resolution, breaking the theoretical resolution barrier.

Market

Nipkov disks are generally used for high-speed imaging; the market for our product is predicted to be larger because it can be used for both standard and fast imaging, programmable photo-activation and super-resolution microscopy.

IP status

Patent applications are currently being prosecuted in the US (US 13/884,679) and in Europe (EP 2638423).

Publication reference

Martial FP, Hartell NA (2012) Programmable illumination and high-speed, multi-wavelength, confocal microscopy using a digital micromirror. PloS one 7:e43942.

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