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MICROSCOPY

Holography images live cells in 3D

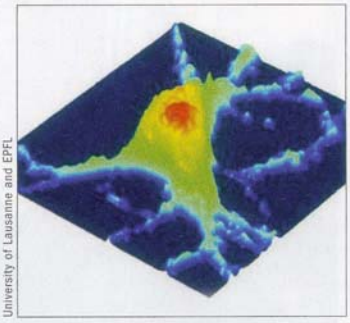
Swiss scientists have used a digital holographic microscope (DHM) to capture 3D phase images of transparent living cells. The team put its system to the test by imaging a living mouse neuron with an axial accuracy in the 160–320 nm range (*Optics Letters* **30** 468).

The researchers from the University of Lausanne and Ecole Polytechnique Fédérale de Lausanne (EPFL) have patented their technique and formed a company, Lyncée Tec, to market and manufacture DHM imaging systems.

The Swiss group's device is based around a Mach-Zehnder interferometer, with a 10 mW helium–neon laser (633 nm) providing the coherent light source. The big benefit of the technique is that it is able to focus on different object planes without using any optomechanical movement.

"Digital processing replaces the need for complex optical adjustment procedures and allows [us] to correct lens aberrations introduced by the microscope objective," research scientist Pierre Marquet told *OLE*. "[It can also] simulate the effect of optical components such as lenses and filters on the reconstructed wavefront."

Lyncée Tec



University of Lausanne and EPFL

The Swiss firm Lyncée Tec has been founded to commercialize and manufacture the DHM (left). A 3D DHM image of a living mouse cortical neuron in culture (right).

Most biological samples, in particular living cells, are transparent and provide little contrast against their background. Fortunately for biologists, these samples have the capacity to alter the phase of a lightwave, and it is this property that the Swiss team exploits in its DHM set-up.

Marquet feels that their technique is considerably simpler to implement than conventional interference microscopy. "Classical interferometric techniques are based on phase-measuring procedures that require multiple interferogram acquisitions and phase-modulation devices," he commented. "These technical constraints explain why very few attempts to use interferometric phase-measurement techniques have been reported in biology for real-time imaging of living cells."

Marquet points out that, until recently, processing power has been the major barrier facing digital holography as a real-time optical technique. Here, the researchers use a PC with a 3 GHz processor to reconstruct and transform their holographic data into 3D at a rate of around 5–7 images per second.

"The main challenge in getting our system to work has been the minimization of coherent noise resulting from the light sources," Marquet revealed.