SUCCESS STORY

Look Inside Life with Nanolive’s 3D Cell Explorer and a Basler ace USB 3.0 Camera

Customer

- NANOLIVE.SA
- Location: Ecublens, Switzerland
- Industry: Biotechnology
- Implementation: 2015

Application

Nanolive SA is a start-up company founded in November 2013 at the EPFL Innovation Park in Lausanne, Switzerland. It has developed a revolutionary microscope which allows for the very first time the exploration of a living cell in 3D without damage to the cell. Since the cell is the basis of all life on earth, this is a major milestone in the history of microscopy, which may change all the rules in the fields of Education, Biology, Pharmaceuticals, Cosmetics, Labs and Industry.

Eric Betzig, winner of the Nobel Prize for Chemistry 2014, says: “You really need to be able to look at living cells because life is animated — it’s what defines life.”

Nanolive’s microscope offers undisrupted and hitherto-unseen insights into the living cell: no need for special procedures requiring intensive and long preparation. As no chemistry or marker is used at all, the observation is completely non-invasive to the cell, and allows resolving the cell’s parts down to 200nm.

The 3D Cell Explorer displays the cell in a completely new format with a comprehensive representation of its morphology, instantly and in 3D.

Solution and Benefits

The 3D Cell Explorer is based on an enabling technology that overcomes the limitation of light. Similar to an MRI/CT-scan in hospitals for the human body, Nanolive’s product makes a complete tomography of the refractive index within the living cell. For the first time it is possible to actually look inside the cell and discover interior features such as nucleus and organelles. Thanks to the 3D Cell Explorer, researchers will never again have to “guess” what happens inside a living cell. They will actually see and measure precisely the impact of stimuli and drugs on cells, thus enabling completely new fields of research and smarter products.

Nanolive’s technology detects the physical refractive index of the different cell parts with resolution far beyond the diffraction limit. Nanolive’s microscope, the 3D Cell Explorer, can be handled without special training.

Nanolive’s microscope, the 3D Cell Explorer, and the software STEVE.

How does it work? Through a combination of holography and rotational scanning the system detects changes to light as it propagates through the cell. The sample is positioned between a high-numerical-aperture air objective beneath the sample and a rotational illumination arm above the sample. Green light (520 nm) from a diode laser is split into sample and reference beams; this optical path forms one arm of a Mach–Zehnder interferometer setup.

The sample beam illuminates the sample through the rotational illumination arm at a very steep angle. A hologram is recorded on a digital camera – the Basler ace USB 3.0 camera acA2000-165um – by combining the beam that has passed through the sample with the reference beam. The sample beam is then rotated by a small angle and the process is repeated, with one hologram recorded for each beam position.

After a series of holograms has been captured, high-resolution images of each plane in the sample are created by computer processing. Improved image resolution is achieved by employing a synthetic aperture and multiple-viewpoint-holographic methods.
For the same purpose, the company has developed an intuitive and unique software called STEVE. To mark and label certain parts of the measured cells in 3D, the software allows the user to “virtually brush” and “digitally paint” the parts of a cell based on their physical properties (called refractive index). STEVE will automatically detect all regions with same refractive index characteristics (different organelles have different optical properties) and digitally stain them with the same color. A trial version of STEVE is directly downloadable from the company’s website. For additional support, Nanolive provides a getting-started video and getting-started document.

Nanolive’s CEO Yann Cotte comments: “The 3D Cell Explorer is a tool for discovery and we are just at the beginning of exploring all the potential fields of research. It allows the measurement of cellular processes and kinetics in realtime, enabling multi-parameter analysis at single-cell and sub-cellular scales.”

Technologies Used
- Basler acA2000-165um for continuous, time-lapse recording of cell behavior
- Nanolive 3D Cell Explorer
- Software STEVE

More Information
http://www.nanolive.ch

Basler acA2000-165um