

A 3-Dimensional (3D) Light-Sheet Scanner

INVENTION:

Salk investigators have developed a novel light-sheet microscope for high-speed 3D volumetric imaging. Its key component is a novel micro-optics device, which makes this 3D light-sheet system robust enough for commercial applications, but also provides single-molecule level sensitivity that previously requires complicated and expensive oil immersion optics, which is often difficult to maintain and impractical for daily usage. This method allows for use of light-sheet imaging for high-speed and high-throughput 3D volumetric imaging and depth-sensing in applications that cannot use a high numerical aperture lens.

APPLICATIONS:

- 3D DNA/RNA sequencing. Imaging DNA colonies in 3D hydrogels with high-speed 3D imaging can increase the density of signal, achieving higher throughput, and consuming less reagent
- 3D High speed imaging
- 3D Live cell cytometry
- Depth-sensing for automatic driving

ADVANTAGES:

- Use light-sheet imaging for high-speed 3D volumetric imaging and depth-sensing
- Single dry objective lens
- No numerical aperture (NA) requirement
- Can be attached to existing microscopes using a low numerical aperture lens
- Long working distance
- Cost-effective; simple and robust

BACKGROUND:

Generally, a camera or microscope generates a 2-dimensional (2D) image of objects located on a plane that is perpendicular to its optical axis. However, it has become increasingly necessary to capture an image of objects located on an oblique image plane. While light-sheet microscopy can image a selected image plane in the sample by merging a series of the imaged planes to generate a 3D volumetric images of the sample, the imaging plane is required to be normal to the optical axis of the imaging camera. Therefore, two or more objective lenses are needed. Further, the axis of the two serially arranged imaging systems that are not parallel to each other results in reduced working distance, increased sensitivity to environmental vibrations, and less robustness in image output. Single-lens light-sheet microscope is a big improvement by using only one lens; however, such microscopes need high-NA immersion lens, has very complex and fragile optical set up, and has a short working distance. To overcome these difficulties, a novel micro optics device is invented that enables light-sheet microscopy with a single low NA dry objective lens, opening up opportunities for high-throughput 3D DNA/RNA sequencing, depth sensing, and cytometry of 3D culture.

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PATENT STATUS: U.S. patent application is pending

PUBLICATIONS: <https://www.salk.edu/scientist/hu-cang/>

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