New Technique for Better 3D Imaging Could Revolutionize 3D Microscopy

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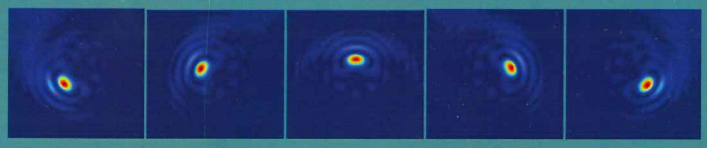
Dr. Sudhakar Prasad, a professor in the Department of Physics & Astronomy at the University of New Mexico, has developed a novel method for producing a 3D point spread function (PSF) that greatly enhances the determination of an image's depth as well as its transverse location without a need for refocusing. This computational imaging approach based on the use of an innovative spiral phase mask design enables a rotating image that keeps its transverse shape and size even in rapid 3D image acquisition when the image scan goes in and out of focus (see figure). The improved sensitivity allows for the recovery of the full 3D location of a point source over a deep focal volume even under low-light levels.

Most lenses, including the human lens, are not perfect optical systems. As a result, when an image passes through a lens, it undergoes a certain degree of degradation. For example, if a small dot of light, a point, is projected through a lens, the image of this point will not be the same as the original because the lens and the finite wavelength of light combine to introduce a finite amount of blur. The PSF is the response of an imaging system to a point source or object. Sometimes called the system's impulse response, the PSF is the blurred image of an object that is unresolved. Allowing PSF to rotate with defocus stabilizes the image's shape against spreading in much the same way a spinning gyroscope is able to maintain its rotational state.

Simulated reconstructions of 3D images from 2D image data acquired using the rotating PSF technology have produced rapid, fully 3D images with high sensitivity. The technology has applications in air-to-ground and space-to-space target recognition and in remote sensing systems but could potentially revolutionize 3D microscopy of biological samples. Three-dimensional microscopy is an evolving technology that has wide ranging applications but is particularly useful in biology where 3D imaging of biological samples such as living cells and tissues can be thoroughly examined to characterize and identify, for example, the three-dimensional structure and dynamics of invasive cells and gene expression profiles. Additionally with 3D microscopy, researchers are able to investigate many complex biological processes in snapshot mode. The range of biological uses for efficient, well-developed 3D microscopy that the new PSF technology would make possible is limitless. ■



Example of PSF rotation over a range of defocus from about -10 μm to +10 μm using visible light

STC has filed a patent application on this exciting new technology and is currently examining commercialization options.
If you are interested in information about this technology, please contact Arlene Mirabal at amirabal@stc.unm.edu or 505-272-8774.

UNM's Center for Molecular Discovery: Where Good Ideas Come From

Lab an Innovative Engine for New Technologies

The growing IP portfolio of one of the University of New Mexico's busiest research and development centers is an example of collaborative academic innovation and commercialization at its best. The Center for Molecular Discovery (CMD), located on UNM's Health Sciences campus, is a drug discovery research lab that has been funded by the National Institutes of Health for ten years. Under the leadership of Distinguished Professor of Pathology Larry Sklar, the CMD was selected by the National Institutes of Health in 2008 as one of only nine national molecular discovery centers in the U.S. with a six-year, $15.5 million grant. The NIH provided another $9.5 million in 2010 to help develop the Innovation, Discovery and Training Complex for CMD. Overall since 1998, the team of researchers at the CMD has generated over $50 million in funding to develop technologies for small molecule discoveries.

National molecular discovery centers generate small molecule probes by performing high-throughput screening, secondary screens and medicinal chemistry for use as new treatments for diseases. The UNM Center for Molecular Discovery (CMD) screens thousands of compounds with the goal of developing them into new and repurposed drugs to treat cancers and other diseases. CMD is an open system of highly collaborative researchers who believe that collaboration is regenerative and empowering. It works with more than 40 scientists at UNM and collaborates with more at the national labs and in industry. CMD is affiliated with the Departments of Pathology (Cytometry Division), Internal Medicine (Translational Informatics Division), Cell Biology and Physiology, Pharmaceutical Sciences (College of Pharmacy), the Clinical and Translational Science Center, and the Cancer Center. CMD lends its expertise to many UNM signature programs in cancer; cardiovascular, immunity, infectious, metabolic and neurological diseases; and childhood, environmental and global health.

CMD is housed in the new Innovation, Discovery, and Training Complex on UNM's Health Sciences Center campus.

Technologies

The Center's advanced screening technologies have led to the discovery of several dozen viable drug candidates, screening methods and tools that are protected by more than 20 issued patents and more than 10 pending patent applications. The compounds, focused in the following drug classes/areas, include G protein coupled receptors for treating breast and prostate cancer; integrins, cell surface protein receptors that play a role in cell migration and adhesion

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