Lawrence Livermore National Laboratory

A LOOK INSIDE THE LIVING EYE

Microelectromechanicalsystems-based adaptiveoptics optical coherence tomography (MEMS-AO-OCT) provides a threedimensional image of the cellular layers within the retina. (inset) An image of the photoreceptor layers within the eye allows physicians to diagnose sight-threatening diseases, such as macular degeneration, in their earliest stages. An optical coherence tomography (OCT) system that incorporates microelectromechanical systems (MEMS) and adaptive optics (AO) can noninvasively observe and record ultrahigh-resolution, three-dimensional (3D) retinal images in real time. Called MEMS-AO-OCT, this device allows precise in vivo visualization and characterization of all the cellular layers in the human retina. It also provides a permanent, digitized record of clinical observations for monitoring disease progression and the effectiveness of therapeutic treatments.

Obtaining a Clear View

In MEMS-AO-OCT, adaptive optics correct and compensate for aberrations from ocular conditions. These conditions distort the light coming into the eye, causing blurred vision and also limiting the image resolution of retinal scans. OCT systems are based on interferometry, where light from a single source is split into a sample and a reference beam. These two separate beams travel along different paths until they ultimately reunite in a detector that measures their interference. Custom computer software interprets the recorded signals and produces high-resolution, 3D, digital images.

It's All in the Details

MEMS-AO-OCT can be easily adjusted to accommodate varying light parameters, making it a valuable tool for diagnosing and treating many health conditions. In addition, its commercial components make the system a financially feasible option for medical practices, and its cost is competitive with existing instruments that have much lower resolution. The system could dramatically reduce the cost of medical treatment and improve the quality of life for millions of people.





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