

Adaptive optics coming of age

**Pippa Wysong
in Fort Lauderdale**

A NOVEL Tracking Adaptive Optics Scanning Laser Ophthalmoscope (TAOSLO) provides hitherto unachievable image resolution, reported researchers at the annual meeting of the Association Research in Vision and Ophthalmology (ARVO).
“Our goal is to advance

The imaging system combines scanning laser ophthalmoscopy (SLO), adaptive optics (AO) and a tracking scanning laser ophthalmoscope (TSLO). The device lets the user view high resolution details such as cone mosaic in the fovea and individual red blood cells in small diameter blood vessels in the retina.

“Because of the adaptive optics, the resolution is much higher than

Potential uses in diagnosis and treatment of eye diseases

Clinically, TAOSLO could potentially be used for the early detection and treatment of retinal diseases, such as age-related macular degeneration and diabetic retinopathy. It could also be used to enable new laser therapies in which individual diseased cells and small structures are destroyed. It may also be useful in monitoring the effectiveness of retinal therapies.

TAOSLO not only enhances the imaging capabilities of adaptive optics scanning laser ophthalmoscopy, but may allow for precise delivery of stimulus or therapeutic laser beams, automatic mosaic generation, and other advanced diagnostic applications.

“One thing you could do is probe individual ganglion cells, if you could get the beam focused to a tight enough spot. That’s something we want to do in the future,” he told *EuroTimes* in an interview.

“People are now adding adaptive optics to optical coherence tomography (OCT) systems, and it has been integrated into scanning laser ophthalmoscopy for a few years. But nobody has come out with a clinical system, because the instrumentation and optics are very complicated. We’re trying to add things to make it easier for the technician to use the system so you don’t have to have PhD to run it,” Dr Hammer said.

Dual imaging system

Indeed, while the system allows

high magnification of a very small area (only one or two degrees of the retina), ophthalmologists will also know exactly where they are in the back of the eye. This is because of a dual imaging system, which simultaneously presents a wide-field image of the entire back of the eye and a high magnification image of a small portion of the retina. The high magnification raster can be placed anywhere in a ‘drag-and-drop’ manner.

“It’s just an enhancement that we added to make it more user-friendly. These systems are eventually going to make it into the clinic. Research collaborators are working towards that, but there haven’t been any companies that have developed a clinical AO system yet,” he said.

TAOSLO also adjusts for eye movements. Tests performed on both humans and animals showed features such as a cone mosaic and individual red blood cells in small diameter blood vessels. At this stage, adaptive optics systems are expensive to build largely because of the deformable mirror technology that is used. Because of this, prototypes used in research cost greater than \$50,000 (USD), but as with many technologies, the cost will come down as the production becomes more efficient.

Under ideal circumstances, the resolution of an optical system is limited only by the diffraction of light waves. But these limits are rarely if ever reached. Adaptive optics refers to optical systems that



Dan Hammer

adapt to compensate for optical effects introduced by the medium between the object and its image. Adaptive optics provides appreciably sharper images, sometimes approaching the theoretical diffraction limit.

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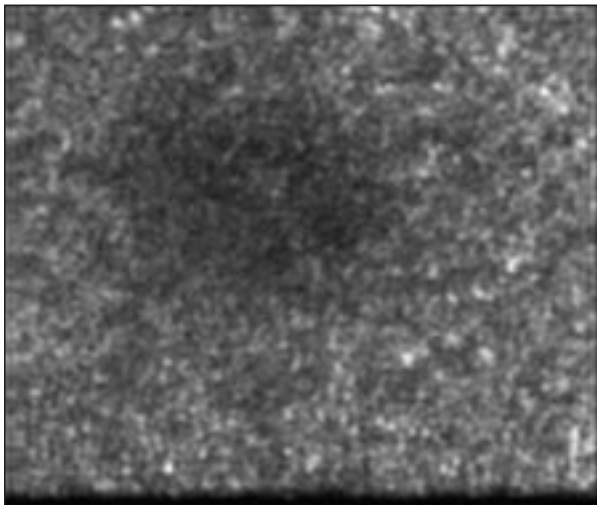


Image of a human cone mosaic in the region around the fovea (darker region) acquired with the TAOSLO.

Courtesy of Daniel X Hammer PhD

technologies to make adaptive optics easier to use,” said Dan Hammer PhD, principal research scientist at Physical Sciences Inc., (PSI) in Andover, Massachusetts, US. He presented details of the device, along with images obtained using TAOSLO on the eyes of six healthy volunteers.

what is available in the clinic today. Ophthalmologists will be able to see many structures that aren’t visible with today’s technology. This would include photoreceptors, ganglion cells, small feeder vessels, and RPE cells, to name a few,” Dr Hammer said.