Improved Three-dimensional Imaging of Living Human Retina Using the Adaptive Optics Scanning Laser Ophthalmoscope (AOSLO)

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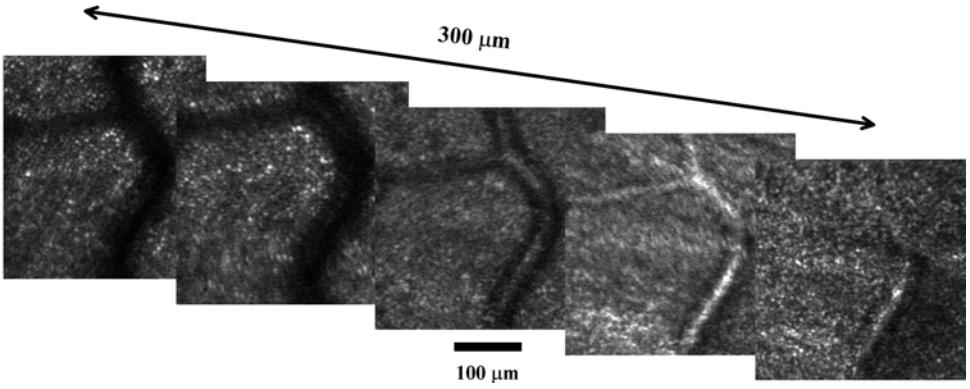
Confocal scanning laser ophthalmoscopy (cSLO) combined with adaptive optics (AO) to compensate for the inherent aberrations introduced by the optics of the eye have helped us image photoreceptors and small capillaries near the fovea of the human retina[1]. Using an 80 μm confocal pinhole at an imaging wavelength of 660nm, the lateral and axial resolution of conventional SLOs are about 5μm and 300μm respectively whereas the adaptive optics scanning laser ophthalmoscope (AOSLO) can produce images with 2.5μm lateral and better than 125μm axial resolution, thereby taking ophthalmoscopy to a microscopic level. The figure shows a series of optical slices from a living human eye obtained using the AOSLO showing photoreceptors (left), blood vessels (center) and the nerve fibers, which run along the retinal surface (right).



Optical slices of a living human retina imaged using AOSLO

We will present the latest axial sectioning results with AOSLO along with other capabilities of the instrument, which include photoreceptor imaging and blood flow. The emphasis will be on the technical details, which include (a) Description of how AO is integrated into the SLO, (b) Presentation of a novel method whereby the adaptive optics system runs continuously in closed loop while the SLO adjust focus to scan through different retinal layers. This method provides optimal AO and achieves near diffraction-limited axial resolution performance, (c) An analysis of the AO system performance and (d) Presentation of a theoretical model to evaluate the performance of the AOSLO and comparison of this with experimental results[2].

1. Roorda, A., Romero-Borja, F., Donnelly, W.J., Queener, H., Hebert, T.J. & Campbell, M.C.W. *Optics Express* **10**, 405-412 (2002).
2. Venkateswaran, K., Roorda, A. & Romero-Borja, F. *Journal of Biomedical Optics* **9**, 132-138 (2004).