

To See or Not to See: Visual Acuity With and Without Adaptive Optics

Luis Henry

University of Houston

Research Advisor: Austin Roorda

Research Supervisor: Siddharth Poonja

Home Institution: Monroe Community College

Aberrations degrade image quality in the human eye and limit the amount of detail a person can resolve from an image with their retinal cones. The goal of this project is to measure the effects of aberrations on visual performance with the Adaptive Optics Scanning Laser Ophthalmoscope (AOSLO). As images get smaller, resolution decreases and images can become blurred. One measure of the smallest detail that can be resolved is visual acuity (VA). To measure VA, a four-alternative forced-choice tumbling E method was used. Using this method, VA is defined as the smallest letter size for which the tumbling E's orientation (up, down, left, right) can be correctly identified 72.4% of the time. We modulated the scanning beam to project an Adaptive Optics (AO) corrected letter 'E' directly onto the human retina using the AOSLO. The E was presented at 7 different sizes ranging from 20/20 to as small as 20/5. VA was measured for three different conditions: i) 6-mm pupil with AO, ii) 6-mm pupil without AO, and iii) 3-mm pupil with AO. For each subject, VA was best with a 6-mm AO-corrected pupil (average VA = 20/11.61), followed by a 3-mm AO-corrected pupil (average VA = 20/12.88). A 6-mm uncorrected pupil provided the worst VA (average VA = 20/17.11). This experiment demonstrates that an aberration-corrected eye will show a significant improvement in VA. After the optical limits to VA are overcome, photoreceptor sampling and possibly neural factors provide the next strongest limitation to further improving VA.



Luis A Henry is a sophomore at Monroe Community College. His major is optical systems technology. Luis has been fascinated with optics ever since high school, when he was given the opportunity to participate in a co-op program. He attended school for half a day and went to work for the other half. This gave him hands on experience and knowledge. Luis now attends school to broaden his horizons and expand his mind.