DRIVING SIMULATOR FOR EVALUATING INTRAOCULAR LENS PERFORMANCE

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One of the effects of ageing can be the clouding of the lens of the eye, called a cataract. The development of cataracts leads to a reduced ability to perform activities of daily life, a subsequent decrease in quality of life, and loss of autonomy and mobility due to the inability to drive safely. Each year 3 million Americans undergo cataract surgery to replace their clouded crystalline lenses with synthetic intraocular lenses (IOLs). Both single-focus and multi-focal lenses are available.

Manufacturers of these lenses must demonstrate their effectiveness under both clinical and functional tests. The recipients of IOLs may potentially experience reduced contrast sensitivity, increased glare sensitivity, and halation effects around light sources. With the support of our sponsors, NADS has developed and validated a driving simulator-based test for evaluating the functional performance of IOL lenses in nighttime driving conditions. The test compares the sign reading and low-contrast object detection abilities of bilaterally implanted multi-focal IOL patients and monofocal IOL patients using a nighttime driving scenario with a condition that simulates oncoming vehicle headlight glare.

The test system is based on existing NADS simulation software, known as the miniSim™, with hardware and software enhancements to support the testing of IOLs. Enhancements included a physical light source to simulate oncoming vehicle headlight glare, and a video and audio recording system to augment the simulator's data acquisition system. Software development centered primarily on the lighting model by which illumination of the signs by the own-vehicle headlights is determined, control of the glare source by the location of oncoming scenario vehicles, and a high-resolution timestamp for recording driver responses. Other significant developments included the sign and object models, visual environment, scenario, test administration protocol, and data reduction code. A commercially available validated tool was used to calculate sign illuminance vs. own-vehicle distance for typical retro-reflective sign materials. One of the key goals of this effort was to produce low-cost, reliable hardware configuration that could be installed in a mobile van. This would allow the sponsor to take the simulator to the patient as opposed to the traditional method of asking patients to come to one specific site. This configuration could also be duplicated to support the notion of having multiple data collection units.

The critical measures obtained from the system include the distances at which driver detection and recognition of signs and low-contract hazards occurred. These measures are obtained both with and without simulated oncoming vehicle glare provided by the light source. The validation demonstrated the required 10-20% reduction in identification distance under the glare condition compared to the non-glare condition for health normal subjects as required by the applicable standard.

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BIO

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Andrew Veit is the miniSim Program Manager at the National Advanced Driving Simulator (NADS). His responsibilities include system design and development, proposal generation, and project management. Besides his work with any and all things miniSim, he contributes to the monitoring, maintenance and upgrades for the NADS-1 simulator, and the 2014 upgrade of the projection system.

Prior to joining the NADS in 2005, Mr. Veit had nine years of experience in the design and development of mechanical test systems based on servo-hydraulic and servo-electric actuation technologies, test engineering, and consulting. Mr. Veit was an employee of Southwest Research Institute (SwRI) for three years doing test engineering, project management, and consulting for a diverse range of commercial and military clients. He was an employee of MTS Systems Corporation for six years doing product development and custom test system design. His product development experience includes mechanical and system design, EMC and safety compliance (CE, UL marks), performance analysis, manufacturing support, and installation and training at customer sites.

Mr. Veit earned his B.S. and M.S. degrees in Mechanical Engineering at the University of Iowa, where his thesis work was in fatigue and fracture mechanics.