AEVR Education

Vision Enhancement System Addresses Defense Vision Research Gaps

On March 22, AEVR’s Decade of Vision 2010-2020 Initiative hosted a Congressional briefing entitled Deployment-Related Vision Trauma Research: A Vision Enhancement System for the Blind and Significantly Visually Impaired. Featured speaker James Weiland, Ph.D., an Associate Professor of Ophthalmology and Biomedical Engineering at the Doheny Eye Institute of the University of Southern California, described his research which addresses two DOD-identified vision research gaps—adequate vision rehabilitation strategies and inadequate vision restoration/vision surrogates. Dr. Weiland was one of twelve domestic and international researchers who received a total of $11 million in awards from DOD in its FY2009/2010 funding cycle.

The vision enhancement system uses modern mobile computing and wireless technology, coupled with novel computer vision and human computer interfacing strategies, to provide information to help those with visual impairment navigate, find objects of interest, and interact with people. The system was designed primarily to assist individuals with visual disorders and blindness as a result of Traumatic Brain Injury (TBI). Recent reports estimate upwards of 200,000 Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) veterans having experienced mild-to-severe vision impairment from TBI and that upwards of 75 percent of all patients with TBI reporting short- to long-term visual dysfunction, such as light sensitivity, double vision, inability to read print, and low vision. This is often accompanied by other cognitive disorders, such as memory loss, which affects an individual’s ability to use past visual cues to navigate.

The system consists of a wearable camera—similar to that in current smartphones—which feeds images (for example, an exit sign in a room) into a computing system that processes, interprets, and identifies it using software algorithms—again, similar to that in current GPS systems and smartphones. The system then provides tactile (e.g. vibration) and/or auditory feedback to the user as guidance, whether to navigate a room (locate an exit sign), locate a specific object (a chair that may block an exit route), or react to another person’s visual cues (facial expression).

Dr. Weiland discussed the various challenges presented by “computer vision,” especially relating to object recognition and targeting. Object recognition can be complicated by light and/or shading on an object, as well as its orientation, which can make an image match difficult. Another challenge is visual targeting, such as identifying the object of interest (for example, a street sign) amidst extensive visual “background clutter.” He also explained that, unlike the human brain which “self corrects” for any blurring that could occur when rapidly scanning an environment with your eye, computer vision must be programmed to avoid distortion of images.

Communicating these computer vision-interpreted images to the user is just as important as capturing them. – Dr. Weiland

Comparing this system to the traditional use of a white cane, he commented that, “You have to be close to an object with a cane to detect it. This system can detect obstacles as far as five meters away and enable an individual to navigate around them. This not only relates to street level obstacles, but to other objects, such as low-hanging branches.”

He concluded by describing other bioelectronics projects being developed at Doheny and other research centers, including an “artificial retina” (which has been approved for sale in Europe), a visual cortex prosthesis which would stimulate the portion of the brain responsible for vision, and electrical stimulation of the eyelid which can restore the blink reflex.