Biomedical Engineering
Wallace H. Coulter Foundation Lecture Series

Retinal Prosthesis for the Blind

James Weiland
Professor of Biomedical Engineering and Ophthalmology & Visual Sciences at University of Michigan

Lecture: Friday, January 25, 2019
9:00AM-10:00AM
Room EC 2300
10555 West Flagler Street
Miami, FL 33174

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Biography

James Weiland received his B.S. in Electrical Engineering from the University of Michigan in 1988. After 4 years in industry with Pratt & Whitney Aircraft Engines, he returned to Michigan for graduate school, earning degrees in Biomedical Engineering (M.S. 1993, Ph.D. 1997) and Electrical Engineering (M.S. 1995). He joined the Wilmer Ophthalmological Institute at Johns Hopkins University in 1997 as a postdoctoral fellow and, in 1999, was appointed an assistant professor of ophthalmology at Johns Hopkins. Dr. Weiland was appointed assistant professor at the Doheny Eye Institute-University of Southern California in 2001, and was promoted to Professor of Ophthalmology and Biomedical Engineering in 2013. In 2017, Dr. Weiland was appointed as Professor of Biomedical Engineering and Ophthalmology & Visual Sciences at the University of Michigan. Dr. Weiland has over 100 peer-reviewed articles and has been PI on research grants from NIH, NSF, and DoD. Dr. Weiland's research interests include retinal prostheses, neural prostheses, electrode technology, visual evoked responses, implantable electrical systems, and wearable visual aids for the blind. He is a Fellow of the American Institute of Medical and Biological Engineering and a Fellow of the IEEE.

Abstract

Retinal prostheses have progressed from laboratory and early clinical experiments, to medical devices approved for sale by the FDA and European Union. This seminar will review the history of retinal prostheses for the blind, focusing in particular on the Argus II implant system, experiments on-going to improve the function of this device, and differences in the visual system of blind people that present challenges to implementation. The clinical trials have shown that individuals who have at best light perception vision, can use spatial information from the retinal prosthesis to detect motion, locate objects, and read letters. Improvements in navigation and mobility have been noted. Experiments in my lab have focused on the use of both human implant patients and animal models of blindness to investigate significant issues facing retinal prostheses. The ability to perceive forms has been inconsistent in the implant patients. Form vision requires the ability to combine percepts from individual electrodes into shapes. An important aspect of form vision is limiting the size of each individual percept to an area near the electrode. In both human subjects and in rodent model retina, we have demonstrated that longer pulses (20 ms) evoke focal responses, while shorter pulses (1-2 ms) evoke elongated responses, the latter being less desirable. Electrophysiological studies of degenerated retina have shown aberrant cell behavior after photoreceptor degeneration that suggests modification to the inner retinal circuitry may influence retinal sensitivity to electrical stimulation. In human studies, cross-modal plasticity studies have demonstrated how the visual cortex of blind individuals is activated by non-visual (tactile) input. How the brain adapts first to blindness and then to vision restoration will have profound impact on the rehabilitation strategies used for retinal prostheses.

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