



Quadruple fluorescence image of the optic fiber layer of a retina

Restoring Sight to the Blind

RESEARCH BY E.J. CHICHILNISKY, PHD

Restoring Vision with an Electronic Retina

The goal of this research is to develop an advanced artificial retina to cure blindness caused by retinal degeneration, the most common cause of age-related vision loss.

THE CHALLENGE

Vision loss and blindness are common symptoms of aging, limiting the quality of life and productivity of millions worldwide. The most common cause of age-related blindness is retinal degeneration, which occurs when light-sensing neurons in the eye degenerate. These retinal neurons are critical since they translate images into electrical signals, generating a neural code that conveys visual information to the brain. However, messenger neurons that communicate with the brain remain intact, which provides researchers like Dr. Chichilnisky a window of opportunity to restore vision.

THE INNOVATIVE RESEARCH

Dr. Chichilnisky has leveraged his expertise in neurophysiology, electrical engineering, computation, and mathematical modeling of the visual system to design an electronic retina that translates images captured by camera into electrical signals. In this design, signals are conveyed to retinal messenger neurons by a complex multi-electrode system—pioneered by Chichilnisky—

which reproduces the neural code with the spatial and temporal precision to communicate complex visual information.

With a Translational and Clinical Innovation Award, Dr. Chichilnisky will perform experiments to specify exactly how this revolutionary hardware will operate to optimally restore vision, paving the way to develop a device for patients. To do so, he will learn to speak the language of retinal neurons, using computational and machine learning tools to mimic how the primate retina translates images into electrical signals. By analyzing neural patterns from single cells up to entire populations of cells, he will develop a complete map of retinal signals over space and time to design the circuitry and software for high-resolution artificial vision.

THE POTENTIAL IMPACT

Restoring vision in people with incurable blindness will profoundly change the lives of millions, restoring their ability to function in society and eliminating one of the greatest challenges of aging. This technology may also spawn a new generation of electronic implants to restore neuronal function or correct neural signals gone awry in diverse forms of neural degeneration, revolutionizing the way we treat incurable disorders such as paralysis, memory loss, and mental illness.

THE RESEARCHER



E.J. Chichilnisky, PhD, John R. Adler Professor, Professor of Neurosurgery, Ophthalmology, and, by courtesy, Electrical Engineering **AWARDS** 2014 Foundation for the National Institutes of Health Sayer Vision Research Award, 2004–2005 McKnight Technological Innovation in Neuroscience Award, 2001–2003 McKnight Scholar Award **EDUCATION** Stanford University, PhD in Neuroscience, '95

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Please note that this document provides a current description of the planned research, however, the goals, methods, staffing and peripheral research may expand and shift over time as projects progress.

