NEWS RELEASE

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Giving Sight to the Blind: NC State Engineer Works on DOE Project to Develop Artificial Retina

FOR IMMEDIATE RELEASE

A North Carolina State University engineer is involved in a national research project that aims to restore vision to millions of people with blindness caused by disorders of the retina.

Dr. Gianluca Lazzi, associate professor of electrical and computer engineering, is collaborating with several universities, a private company and U.S. Department of Energy (DOE) national laboratories to create a safe and efficient artificial retina that would work like a healthy retina and restore sight to people with diseased retinas or age-related retinal disorders.

The artificial retina could help those blinded by age-related macular degeneration or retinitis pigmentosa where neural wiring from the eye to brain is intact, but the eyes lack photoreceptor activity. The artificial retina is a device that captures visual signals and sends them to the brain in the form of electrical impulses. The device relies on a miniature chip to control an array of electrodes implanted in the eye – in contact with the retina – to stimulate the surviving nerves and cells of the retina and therefore impart vision. Visual signals are captured by a small video camera in the eyeglasses of the blind person and processed through a microcomputer worn on a belt. The signals are transmitted to the electrode array in the eye. The array stimulates optical nerves, which then carry a signal to the brain. The prototype implants contain 16 electrodes. The next prototype, with 50 to 100 electrodes, is in preclinical trials. The project's "next generation" device would have 1,000 electrodes and hopefully would allow the user to perform tasks such as face recognition.

However, implanting a device which uses a large number of electrodes to selectively stimulate the retina with small electrical currents presents unique challenges. Lazzi has found that the effectiveness of the artificial retina can be greatly affected by the size and shape of the electrodes in the array, as these differences change the flow and direction of the current. Further, the operation of the artificial retina will result in heat dissipation inside the human eye, which must be minimized.

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Using human body models derived from images of MRI scans, Lazzi is performing electrical and thermal modeling to help design the optimal electrode array configuration to achieve spatially selective neural stimulation, while determining the overall thermal characteristics of the implant to ensure that the heat generated by its operation is within safe limits.

"The retina is extremely delicate, so we want to design the entire system in such a way as to minimize the impact of heat and shift heat away from the retina," Lazzi says.

Lazzi was NC State's representative at a research partnership event in Chicago on Oct. 14 in which Secretary of Energy Spencer Abraham announced the research partnership between the five DOE national laboratories, a private company and three universities. NC State's partners in the effort include Argonne National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Sandia National Laboratories, the University of Southern California Doheny Eye Institute, the University of California-Santa Cruz, and Second Sight Medical Products Inc.

At the Chicago announcement, the first patient to receive a prototype implant in 2002 described what it was like being able to "see" large letters and to differentiate between a cup, a plate and a knife after being blind for over 50 years. To date, six volunteers have received implants of a micro-electronic device that rests on the surface of the retina to perform the function of normal photoreceptive cells. The artificial retina technology was featured at the department's "What's Next Expo," an event designed to showcase the newest, most innovative, cutting-edge scientific and technological advances to interest young people in pursuing careers in math and science.

The project's goal is to construct the device, capable of restoring vision, with materials that will last for the lifetime of a blind person. Although images will initially be captured by a miniature camera on patients' eyeglasses, researchers hope eventually to develop a completely implanted system for this purpose. DOE's effort is focused on developing high-grade microelectrodes and testing their long-term biological effects, developing electrode and platform materials that are pliable and will last a lifetime within the eye, constructing a completely wireless device for clinical use, and performing the computational modeling of long-term retinal stimulation.

The Energy Department's Office of Science plans to fund the artificial retina project at $20 million over the next three years. The National Institutes of Health and the National Science Foundation are also supporting the project.

Additional information on the artificial retina project is available at *www.science.doe.gov*.

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