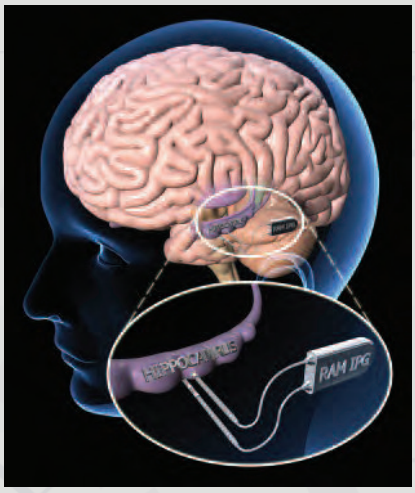
UCLA Electrical Engineering Plays Key Role in DARPA "Neuroprosthesis" Research

Professors Markovic and Sayed participate in a US$15 Million project to restore memory function in victims of brain injury

The UCLA Henry Samueli School of Engineering and Applied Science has been tapped by the Defense Advanced Research Projects Agency (DARPA) to play a key role in an innovative project aimed at developing a wireless, implantable brain device that could help restore lost memory function in individuals who have suffered debilitating brain injuries and other disorders. The four-year effort, to be led by UCLA's Program in Memory Restoration and funded by up to $15 million from DARPA, will involve a team of experts in neurosurgery, electrical engineering, neurobiology, psychology and physics who will collaborate to create, surgically implant and test the new "neuroprosthesis" in patients.

This ambitious, first-of-its kind project at UCLA builds on a 2012 research by Professor Itzhak Fried, from the David Geffen School of Medicine and lead investigator on the project, demonstrating that human memory can be strengthened by stimulating the brain's entorhinal cortex, a region involved in learning, memory and Alzheimer's disease.



Ultra low power electronics to be developed at UCLA will be implanted in memory loss patients to restore memory fuctions

Dejan Markovic, Associate Professor of Electrical Engineering, will lead a group of UCLA HSSEAS researchers developing technology to stimulate and record the activity of single neurons and of small neuronal populations. Electrical Engineering Professor Ali H. Sayed's research group will develop adaptive signal processing techniques to detect and supress artifacts to enable the reliable recording of neuro-physiological signals. DARPA will provide US$4.5 million over four years for the UCLA Electrical Engineering effort, contingent on researchers meeting a series of technical milestones. UCLA partners include the Lawrence Livermore National Laboratory and Stanford University.

Memory is the process by which neurons in certain brain regions encode, store and retrieve information. Various illnesses and injuries can disrupt this process, causing memory loss. Traumatic brain injury, which has affected more than 270,000 military members since 2000, as well as millions of civilians, is often associated with such memory deficits. Currently, no effective therapies exist to address the long-term effects of these injuries on memory.

Dejan Markovic and Ali H. Sayed

In a key part of the project, the research team will stimulate and record neuron activity in patients who already have brain electrodes implanted as part of epilepsy treatment. Researchers will use this information to develop computational models and determine how to intervene with electrical stimulation to help restore memory function. The models will be transformed into therapeutics using technology developed by Markovic's team.

Professor Markovic said the goal is to create miniature wireless neural sensors that are far more sophisticated —much smaller and with much higher resolution—than those that exist today. The sensors will track and modulate neural activity with very precise spatial and temporal resolution, allowing the device to continuously update and modulate patterns of stimulation to optimize therapy and restore memory function.

"We are developing ultra–low-power electronics in order to measure activity of specific areas of the brain, perform neural signal analysis and wirelessly transmit that information to an outside device in close proximity to the implants," Markovic said. "The implants and the outside device will talk to each other. The goals are to provide better therapy for people with neurological dysfunction and help those with epilepsy and brain injury to enhance and restore memory."

During the second phase of the program, Professor Itzhak Fried will implant the device in patients with traumatic brain injury in clinical trial. The DARPA initiative aimed at developing these implantable brain devices, Restoring Active Memory (RAM), supports President Obama's BRAIN initiative.

—by Bill Kisliuk