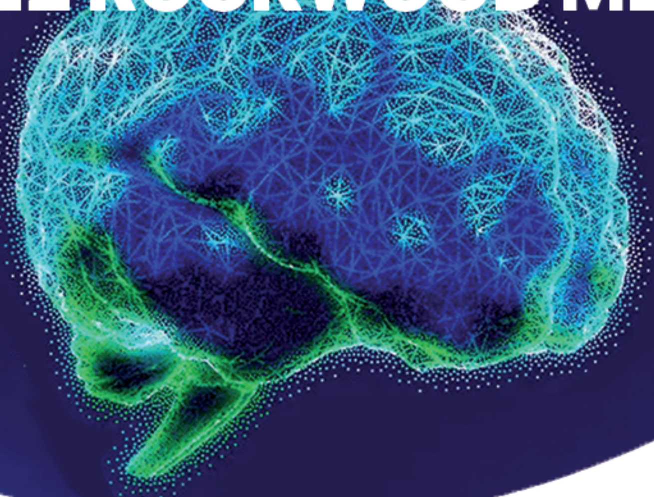
THE INSTITUTE FOR NEURAL COMPUTATION

2022 ROCKWOOD MEMORIAL LECTURE



BRAIN-COMPUTER INTERFACES CREATE SYNTHETIC HEKSORS

Jonathan R. Wolpaw, M.D., National Center for Adaptive Neurotechnologies,
Stratton VA Medical Center and State University of New York at Albany

When: Thursday, **November 17th - 5:00-6:00 p.m.**; Light reception to follow
This talk is associated with EEGLAB Workshop 2022 and the free symposium that same day
Location: San Diego Supercomputer Center Auditorium
Hosts: Terry Sejnowski, Ph.D., Gert Cauwenberghs, Ph.D., Scott Makeig, Ph.D., and Arnaud Delorme, Ph.D.

The CNS acquires and maintains useful behaviors (skills) produced by muscles. Brain-computer interfaces (BCIs) enable the CNS to acquire nonmuscular skills produced by brain signals. BCI development can benefit from recent advances in understanding natural (muscle-based) skills. Each is produced and maintained by a unique CNS entity, which we call a heksor. A heksor is a widely distributed network of neurons and synapses that changes itself as needed to maintain the key features of a skill, the features that make the skill satisfactory. Heksors share the CNS and overlap each other. Through their concurrent changes, heksors negotiate the properties of the neurons and synapses they all use, and keep the CNS in a state of negotiated equilibrium that enables each heksor to maintain the key features of its skill. The heksor and negotiated equilibrium concepts are supported by animal and human studies, explain otherwise inexplicable results, underlie promising new therapeutic strategies, and offer new answers to questions such as generation and function of spontaneous neuronal activity, etiology of muscle synergies, and control of homeostatic plasticity. These new concepts can also guide BCI development. A BCI creates what is best described as a synthetic heksor. A synthetic heksor is a network of neurons and synapses combined with adaptive software; network and software adapt to each other so as to maintain the key features of a nonmuscular skill. Present interest focuses on three kinds of synthetic heksors. First, a BCI can create a therapeutic synthetic heksor that targets beneficial plasticity to a crucial site in a natural heksor that has been damaged by a stroke or other lesion (e.g., the locomotion heksor); this triggers wider plasticity that restores the natural skill. BCIs of this kind are entering clinical use. Second, a BCI can create a synthetic heksor that replaces a communication or control skill lost to injury or disease. BCIs of this kind are not yet suitable for applications that require the speed, accuracy and – most of all – the reliability of natural skills. Their improvement hinges on integrating the synthetic heksors they create with the natural heksors that share the CNS. Third, a laboratory BCI can create synthetic heksors that illuminate principles underlying negotiations among natural heksors in the healthy CNS.

The H. Paul Rockwood Memorial Lectures are endowed to the Institute by Mr. and Mrs. Jerome Rockwood in memory of their late son's interest, studies, and work in the neural computation field. Paul Rockwood received a B.S. in Computer Science from UC San Diego in 1980 and a second B.A. degree in Psychology in 1981. In 1983, he started a company, Integral Solutions, to develop universal language translation, but died tragically in a mountaineering accident before he could fulfill his promise.

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