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University Hospitals Neurological Institute

Neural Prosthesis Seminar

"A Learning-Based Approach to Artificial Proprioception"

Friday, January 16th, 2015 • 8:00 AM
Kulas Auditorium
University Hospitals

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Abstract

Proprioception—the sense of the body's position in space—is important to natural movement planning and execution and will likewise be necessary for successful motor prostheses and brain–machine interfaces (BMIs). I will present our recent work on the development of a learning-based approach to delivering artificial proprioceptive feedback. This work is motivated by the theoretical observation that movement planning and control rely on information from multiple sensory modalities, and that these signals are combined in a statistically optimal and highly adaptive manner. We have shown how a simple network model can learn to perform such multisensory processing, driven only by the common statistics of its inputs, e.g., by spatiotemporal correlations between sensory modalities. When then demonstrated that the same principle can be used to train animals to use an artificial sensory signal. In particular, we paired known visual feedback with an initially unfamiliar (and non-biomimetic) multichannel intracortical microstimulation signal that provided continuous information about hand position relative to an unseen target. After learning, the animals were able to use this signal to guide naturalistic movements. Furthermore, they combined the artificial signal with vision to form an optimal estimate of hand position. These results demonstrate that a learning-based approach can be used to provide a rich artificial sensory feedback signal, suggesting a new strategy for restoring proprioception to patients using BMIs, as well as a powerful new tool for studying the adaptive mechanisms of sensory integration.

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This seminar will not be webstreamed.

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