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Advancing brain-machine interfaces towards clinical viability

Abstract

Brain-machine interfaces (BMIs) aim to restore function for people with disabilities by directly interfacing with the nervous system. A key challenge in advancing these systems is developing frameworks to accurately estimate and perturb the state of the brain in real-time. I will demonstrate the development and application of such frameworks to two emerging classes of BMIs: retinal prostheses to restore vision, and intracortical motor prostheses for people with paralysis. In the case of retinal prostheses, I will discuss a novel high-fidelity approach that combines optogenetic interfaces with detailed modeling of the retina's output, which we demonstrated in a rodent model of blindness. In the case of motor prostheses, I will discuss our recent results, as part of the BrainGate2 pilot clinical trial, towards the development of a high-performance communication interface. This approach, tested with two research participants with motor impairment, achieved the highest continuous control quality and communication rates to date using a BMI. The insights gained from these studies motivate interdisciplinary approaches towards the control of complex end effectors (e.g., dextrous robotic arms) that leverage innovations across systems engineering and systems neuroscience.

Bio

Dr. Pandarinath's research centers on understanding how the brain represents information and intention, and leveraging these insights to develop high-performance, robust, and practical assistive devices for people with disabilities and neurological disorders. He received his bachelor's degrees in Computer Engineering and Physics from North Carolina State University, Ph.D. in Electrical Engineering from Cornell University, and is currently a postdoctoral fellow at Stanford University in Neurosurgery and Electrical Engineering. He is the recipient of the Craig H. Neilsen Foundation Postdoctoral Fellowship in spinal cord injury research and the Stanford Dean's Fellowship, and was a finalist for the 2015 Sammy Kuo Award in Neuroscience from the Stanford School of Medicine.