

## **BIO:**

Richard Andersen is the James G. Boswell Professor of Neuroscience and the T&C Chen Brain-Machine Interface Center Leadership Chair at Caltech. Andersen obtained his Ph.D. from the University of California, San Francisco and completed a postdoctoral fellowship at the Johns Hopkins Medical School. He was a faculty member of the Salk Institute and MIT before coming to Caltech. Andersen discovered *gain-fields*, the method the brain uses to transform signals between spatial representations. He also discovered neural signals of *intention*, proving that they are not sensory in nature but rather reflect the planning of the subject. He has applied this discovery of intention to advance research in brain-machine interfaces, showing that paralyzed patients' intentions can be decoded from brain activity to control assistive devices such as robotic limbs. Andersen is a member of the National Academy of Sciences, the National Academy of Medicine, and the American Academy of Arts and Sciences.

## **ABSTRACT:**

Every year, thousands of people suffer spinal cord injuries at the level of the neck that lead to tetraplegia, the loss of movement and feeling in all four limbs. We study how the brain encodes movement and speech, with the goal of developing brain-machine interfaces (BMIs) that can help people with paralysis by allowing them to control external assistive devices with their thoughts. A BMI consists of tiny electrodes that can record the activities of large numbers of cortical neurons, together with machine learning algorithms that can interpret the person's intent based on the recorded neural activity. We use a novel approach to BMIs: implanting electrodes in a variety of specialized cortical areas rather than in the motor cortex alone. This approach has enabled study participants to control robotic limbs and computers that, in turn, have enabled them to drink a beverage, play a computer piano, use software, and drive an automobile. "Bi-directional" BMIs can supplement the control of a robotic limb with an artificially induced sense of touch in previously insensate hands and arms. The team is also working on BMIs with the potential to decode the inner dialog we have with ourselves toward the end of restoring speech.