

## **Decoding motor imagery from posterior parietal cortex in tetraplegic humans**

**Richard Andersen, Caltech**

The posterior parietal cortex (PPC) is an interesting area of the cerebral cortex that bridges sensory areas and motor areas and accomplishes sensory to motor transformations. In recent years we have demonstrated in recordings from animals that the PPC represents the initial intent for movements. Moreover, there is a map of intentions in PPC, with areas specialized for reaching, grasping and eye movements.

This finding of intent signals in PPC has led us to investigate whether these signals could be used for neural prosthetic applications. Clinical studies for neural prosthetics so far have only used neural activity recorded from motor cortex. Motor cortex signals are near the motor output, being associated with the execution of movement, whereas the PPC signals are more high-level, being more concerned with abstract qualities of the intent of the subject.

We are currently recording from arrays of microelectrodes implanted in two areas of the PPC of three tetraplegic patients. In each subject, one array is located in a region specialized for grasping and the other in a region specialized for reaching. We decoded the subjects' intent from the population of action potentials recorded from these arrays and used this decoded signal to control a robotic limb and a computer cursor.

Among the novel findings: 1) The signals in PPC are surprisingly specific for imagined complex movements. 2) PPC represents both the goal of the movement and the trajectory of the movement (motor cortex primarily represents the trajectory). The intended goal can be read out very quickly (within 190ms). 3) Cells are selective for grasp postures which were used to control grasping by the robotic hand. 4) Whereas motor cortex only represents the contralateral limb, PPC represents intended movements of both limbs with cells specialized for one or the other limb or both limbs. This finding raises the possibility of bimanual control from a single cerebral hemisphere. 5) Cells in the grasp area are more selective for visual objects that can be grasped. 6) The intent activity associated with imagined movements occurs before the awareness of intent. 7) Higher level intentions that are more general than motoric intentions are also represented in PPC.

In conclusion, we have shown that the intention-related activity in the PPC is a rich source of control signals for a cognitive neural prosthetic.