American Association of Neurological Surgeons (AANS) Annual Meeting (2004)
Orlando, FL

Premotor cortex plan activity used to decode upcoming reach speed for high performance neural prosthetic system design

Stephen I. Ryu, Byron Yu, Mark M. Churchland, Krishna V. Shenoy

INTRODUCTION

Neural prosthetics will one day assist patients with impaired mobility, using neural signals to guide a cursor or prosthetic device. Optimizing performance will depend on successfully 'decoding' information about the patient's desired movement. This problem is similar to estimating the actual movement in an intact subject. We report an algorithm that decodes the speed of a monkey's reach from preceding neural activity.

METHODS

Neural activity was recorded from the premotor cortex of a rhesus monkey. The monkey was trained to perform delayed reaches at two different speeds to targets arrayed in two directions on a video screen. Extracellular action potentials were recorded from twenty-four isolated neurons. Our analysis concentrated on 'plan' activity: neural activity after the appearance of a target and before movement onset. We asked how well we could estimate the direction and speed (fast or slow) of the actual reach, based on the collective plan activity of the recorded neurons.

RESULTS

It was possible to correctly classify 93% of the simulated reaches using activity from 18 neurons. (Chance performance is 25%.) Six of the 24 neurons were excluded from the performance analysis as they did not improve overall performance. Reach distance could also be estimated, although nearby distances were frequently confused.

CONCLUSIONS

Speed of upcoming reaches has been found to be encoded in the plan period and can be decoded effectively along with direction. Much of prosthetic performance will be determined by our ability to enhance extraction of and to better understand the information provided by neurons.