Session 247 - Reaching: Neurophysiology

Add To Itinerary

247.20 / TT2 - Decoding kinetic information from PMd and M1 during reaching

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Presenter at Poster
Sun, Nov. 13, 2016, 4:00 PM - 5:00 PM

Session Type
Poster

Authors

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Disclosures

E. Trautmann: None. **S. Stavisky:** None. **J. Kao:** None. **S. Ryu:** None. **K. Shenoy:** None.

Abstract

Several experiments have characterized the tuning properties of neurons PMd and M1 when loads are applied to the arm [Kalaska 1989, 2005], though less is understood about the relationship between population-level neural dynamics and reach kinetics. Here, we report how neural dynamics in PMd and gyral M1 adapt to external loads to control force, demonstrating that the arm's output force along the vertical axis can be decoded from neural activity before and during movement.

Two rhesus macaque monkeys, implanted with two 96 electrode arrays in PMd and M1, made delayed reaches in a vertical workspace to eight targets with three levels of added weight: 0g, 100g, or 200g. Weights were attached to the top of the wrist for randomly selected blocks of 250 trials. At the start of a trial, monkeys held their arm at the center, resisting gravity against the different weights.

For monkey J, 109 of 192 (monk R: 50/171) electrodes' multiunit activity displayed tuning to the applied weight, while 170/192 (80/171) displayed target tuning. While statistically significant, the applied weights modulated firing rates only modestly. Despite this, we asked whether it is possible to discriminate the level of weight attached from the neural activity before movement. Classification accuracy between the 0g and 200g weight levels was 75.3% (58.9%), using a multi-class SVM with 10-fold CV.

We used the SVM to define a neural Gravity Force Axis (GFA) that best discriminates applied weight before movement, and ask whether this axis contains information about the arm force generated in the vertical dimension during the reach. Targets at the top and bottom of the workspace require different force profiles to accelerate the arm with or against gravity. We modeled the required force profile for each target, and compared this to the trial-averaged force decoded from the projection of the neural state along the GFA. The correlation coefficient between decoded force and modeled force was .67 (.26), suggesting that this axis can serve as a readout of behavioral kinetics along one dimension of physical space.

Curiously, the percentage of neural variance captured by the GFA was only 0.7% (0.59%). The top principal components of neural activity are dominated by the large changes in firing rate during the movement period, which are largely independent of the total force. Despite this, we show that kinetic information is available in the population activity in gyral PMd and M1, amenable to recordings using multielectrode arrays, and potentially important as an additional channel of information for controlling neural prosthetic devices.