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Presentation Abstract

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Title:	Low dimensional neural features predict specific muscle EMG signals
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Authors: ***Z. RIVERA ALVIDREZ**[1], R. S. KALMAR[2], S. I. RYU[3,1], K. V. SHENOY[1,2]; [1]Electrical Engin., [2]Neurosci., Stanford Univ., Stanford, CA; [3]Neurosurg., Palo Alto Med. Fndn., Palo Alto, CA

Abstract: Understanding the relationship between neural activity in motor cortex and muscle activity during movements is important both for basic science and for the design of neural prostheses. While there has been significant work in decoding muscle EMG from neural data, decoders often require many parameters, making the analysis susceptible to overfitting. Overfitting reduces generalizability and can make the results difficult to interpret scientifically. To address this issue, we recorded simultaneous neural activity from the motor cortices (M1/PMd) of two rhesus monkeys performing a non-delayed arm-reaching task to a grid of targets arranged in concentric rings (max radius = 12 cm) while recording EMG from arm muscles. In this work, we focused on relating the mean neural activity (averaged across all reach trials to one target) to the corresponding mean EMG. In order to obtain a more compact representation of the neural population, we used dimensionality reduction. We reduced the dimensionality of the neural data using factor analysis and found that salient features of the low-dimensional (low-D) neural activity could be matched to to salient features of the EMG data. Using these features as a signature of muscle activity, we derived low-D neural measures based on reaches to only one reach target (<5% of the data) that could explain EMG for reaches across multiple targets (average R^2 = 0.65). Because we did not directly fit the EMG data to the neural activity, our method is unlikely to overfit and the neuron-to-EMG relationship found has implications for the mechanisms of motor control. Our results suggest that the population activity of cortical neurons of unidentified type is tightly related to muscle EMG measurements, predicting a lag between cortical activity and movement generation of 48 ms. This lag is longer than the estimated delay between corticomotoneuronal single-cell firing and postspike EMG facilitation (McKiernan, et al., 1998), but in agreement with lag estimations based on optimal correlations between M1 cell firing and EMG (Miller, et al., 2003). Furthermore, our ability to predict EMG features across different kinds of movements suggest that there are signatures in low-D neural space that correspond to activation of particular muscles.

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