Semi-blind Decoding of Multi-finger Movements Using M1 Neurons

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***Abstract*—We present an evidence of correlation between single and multi-finger movements and also attempt a challenging task of semi-blind decoding of neural data with minimum training of the neural decoder. Data were collected from 115 task-related neurons in M1 of a trained rhesus monkey performing flexion and extension of each finger and the wrist (12 single and 6 two-finger-movements). By exploiting correlation of temporal firing pattern between movements, we found that correlation coefficient for physically related movements pairs is greater than others; neurons tuned to single finger movements increased their firing rate when multi-finger commands were instructed. According to this knowledge, neural semi-blind decoding is done by choosing the greatest and the second greatest likelihood for canonical candidates. We achieved a decoding accuracy about 90% for multiple finger movement without corresponding training data set. These results suggest that only with the neural activities on single finger movements can be exploited to control dexterous multi-fingered neuroprosthetics.**

I. Introduction

We exploit correlations in monkey M1 neurons between finger flexing/extending movements. If there is a neural correlation between single and multi-finger movements, the correlation makes it possible to decode multi-finger movements only with single finger related neural information.

II. Methods & Experimental Results

We measured relation between the peri-event time histograms corresponding two movements of a given neuron by the Pearson's correlation coefficient. For physically related single and multi-finger pairs, the correlation coefficient values were as high as 0.7 and, for uncorrelated pairs the correlation coefficient values were as low as 0.3 or less. Thus, fundamental neural network for both single and multiple finger movement exist. Furthermore, we proposed a blind neural decoder for multi-finger movements which needs training with just single finger movement data. Assuming that 6 two-finger movement sets are known, the decoding accuracy was found to be as high as 90% with 100 neurons.

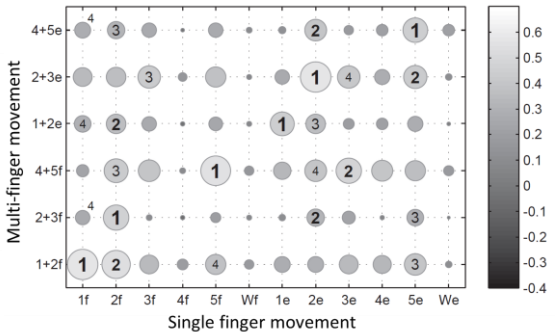

Figure 1. Neural correlation of 20 high responding neurons between single and multi-finger movement during 'Onset' period. The size and the intensity are proportional to correlation coefficient between PETHs.

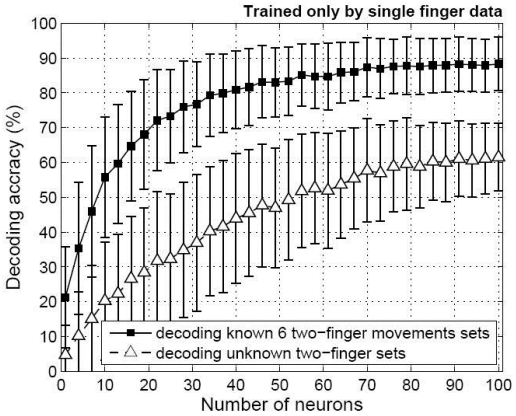

Figure 2. Blind multi-finger decoding accuracy. The upper curve is the decoding accuracy without multi-finger training data but assuming six multi-finger types are known. The lower curve is the accuracy without multi-finger training data set and no assumption on multi-finger types.

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