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Trial - by - trial mean normalization improves plan period reach target decoding

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In an instructed delayed reach task, delay period activity from PMd is known to reflect the direction and distance of the upcoming reach. However, firing may also be correlated to internal factors, such as motivation or attention, or to other behavioral properties, such as reach speed. By estimating the impact of extraneous factors on firing rate, we can build better decoders. As described in this volume (Santhanam et al.), two rhesus macaques, G and H, were trained on a center-out delayed reaching task to 1 of 8 targets; neural activity was recorded from a 96 electrode array in PMd. For a single reach direction, the mean firing rate of a population of simultaneously recorded single and multi neuron units is variable (e.g. leftward reaches have a mean firing rate of 3.4 ± 1.1). To explore this finding, two different multivariate Poisson models were generated. The first model assumes independence between the firing rate of each unit. The second model assumes the firing rate of each unit is coupled to the population's mean firing rate; accordingly, the model scales the expected firing rate of each unit by this mean firing rate on each trial. These models were fit offline to the first 200 trials of the day and were tested on trials from the remainder of the day. For monkey G (H), when decoding on 150ms of delay period activity, the first and second model correctly classify reach direction on 55% (75%) and 66% (78%) of the trials, respectively (chance=12.5%). Across multiple daily data sets collected over a period of several weeks, the second model consistently outperforms the first model. If we adjust the expected firing rate of individual neurons according to mean firing rate, we may improve discrete classification and continuous estimation of reaches from neural activity. Improving these processes will move us closer to realizing effective neural prosthetic systems.

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