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IMPROVING CLASSIFICATION PERFORMANCE OF NEURAL PROSTHETIC SYSTEMS BY COMBINING PLAN AND PERI−MOVEMENT ACTIVITY

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While most neural prosthetic systems to date estimate arm movements based solely on the activity prior to reaching movements during a delay period (plan activity) or solely on the activity during reaching movements (peri−movement activity), we asked whether and by how much classification performance would improve by using both types of activity together. We trained a rhesus monkey to perform a delayed−reach task to one of seven radial targets. Neural activity was simultaneously recorded from single (47) and multi (78) neuron units on a 96−channel electrode array in the dorsal pre−motor cortex. We fitted the trial−by−trial firing rates across the neural population with a multivariate Gaussian and decoded using maximum likelihood. Compared to using only plan activity or only peri−movement activity, we found that decoding using both types of activity improved classification performance by 56% and 71%, respectively. These results assumed independence between units and across time periods within a given trial condition. We then considered a second−order model that took into account pairwise covariances, which did not improve performance. Consistently, we observed low correlations in activity between pairs of simultaneously−recorded units and across time periods. Lastly, taking into account the time−varying structure of peri−movement activity yielded an additional 15% performance improvement, while doing the same for plan activity did not improve performance. This work demonstrates that decode performance can be significantly improved by using plan and peri−movement activity together.

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