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Presentation Abstract

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Abstract: Neural control of movement is typically studied in constrained environments that reduce the set of possible behaviors. Examining a limited subset of behavior may limit the applicability of findings to more general unconstrained behavior. We hypothesize that exploring a wider range of behavior will lead to new insights in the neural control of movement and help advance the design of neural prosthetic decoding algorithms. To study a wide range of behaviors, we use a head-mounted device that wirelessly transmits neural activity as well as multiple video cameras to measure behavior via computer vision algorithms. Here we present our progress on both fronts. Using the "HermesD" system (Miranda et. al. 2011), we recorded and wirelessly transmitted broadband neural data from 32 electrodes in premotor cortex while acquiring video from 8 camera views of a rhesus macaque walking on a treadmill and reaching for food. We divided 252 epochs of time, from one day's recording session, into 8 behavioral categories: the swing phase of walking, the stance phase of walking, reaching for food, bringing food to his mouth, dropping hand from mouth to ground, reaching for food while walking, sitting idly, and standing idly. We demonstrate an ability to correctly classify 96% of the epochs based on average neural firing rates of each channel using regularized multivariate Gaussian discrimination with leave-one-out cross-validation. Epochs were hand labelled, and we aim to automate behavior measurements from video. To that end, we developed a deformable articulated 3D monkey model that we can pose to match video recordings in order to obtain kinematic measurements. The 3D surface ('skin') deforms non-rigidly as a function of the hidden 3D skeleton, and thus our model goes beyond traditional models that exploit only geometrical primitives such as cylinders. Such a model provides a more accurate representation of body shape and pose, allowing more accurate matching of the model to image measurements. Together, the neural recording and improved automated behavioral measurements can be combined to enable a freely moving monkey model and may help to broaden our understanding of the neural control of movement.

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