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Presentation Abstract

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Title:	Neural decoding of goal-directed reaches: scaling up the number of reach goals
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Abstract: Abstract: Recursive Bayesian decoders have been used successfully in neural prosthetic systems to estimate arm trajectories from neural data. These decoders require the specification of an observation model, which describes how the neural activity relates to the arm state, and a trajectory model, which describes how the arm state changes from one time step to the next. The observation model often assumes linear cosine tuning. For goal-directed reaches, we recently showed that using a mixture of trajectory models (MTM) yields more accurate decoded trajectories than using a single trajectory model (STM) (Yu et al., J Neurophysiol, 2007). Importantly, our previous work focused primarily on center-out reaches to 8 possible goals arranged around a ring (i.e., 8 directions at one distance). Here, we investigate how the performance of these decoders scales as the density of goals increases, namely with more directions and more distances. We decoded arm trajectories of one rhesus macaque performing ~7000 consecutive center-out reaches (non-delayed) to 40 goal locations arranged in 4 rings (i.e., 10 directions and 4 distances). Simultaneous neural activity was recorded using a 96-electrode array in the monkey's premotor cortex (172 units). We found that the performance of the MTM decoder trained on all 40 goal locations, when evaluated on the two outer rings (radial distances of 95 and 120 mm), yielded an RMS error of 15.3

mm, which was well below the RMS error of an STM decoder trained and tested on the same set of trials (22.4 mm), and comparable to the combined RMS errors computed for two MTM decoders trained and tested separately on goal locations at each of the two distances (14.5 mm). When evaluated on the two inner rings (radial distances of 45 and 70 mm), the performance of the MTM decoder trained on all 40 target locations degraded considerably producing an RMS error of 23.1 mm, compared to the similarly trained STM decoder (14.6 mm) and the combined RMS errors of MTM decoders trained and tested on each distance separately (11.3 mm). The reduction in performance is, at least in part, due to the inadequacy of the cosine tuning model to capture the neural firing rate profiles for all goal directions and distances considered. Nevertheless, we found that the MTM performance scaled remarkably well to the 20 goal locations on the two outer rings. Our results indicate that better observations models will need to be developed to accurately decode movements directed towards goals located at many possible distances and directions.

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