Kinematic encoding model of ECoG activity in the contralateral and ipsilateral hemisphere during a reaching task

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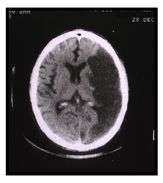
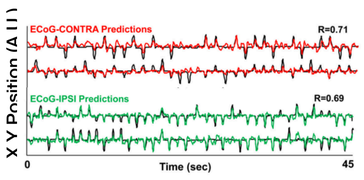
Introduction

A primary tenant of neurology is the contralateral organization of movement



Middle cerebral infarct

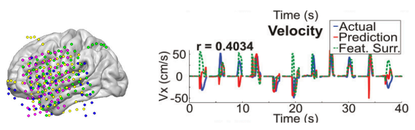
Successful kinematic decoding from ipsilateral hemisphere (ECoG & Single units)



Ganguly et al., 2009

Kinematic decoder trained on one arm can generalization to the other arm

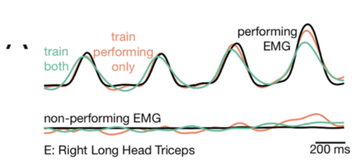
Decoder trained on ECoG grid



Bundy et al., 2018

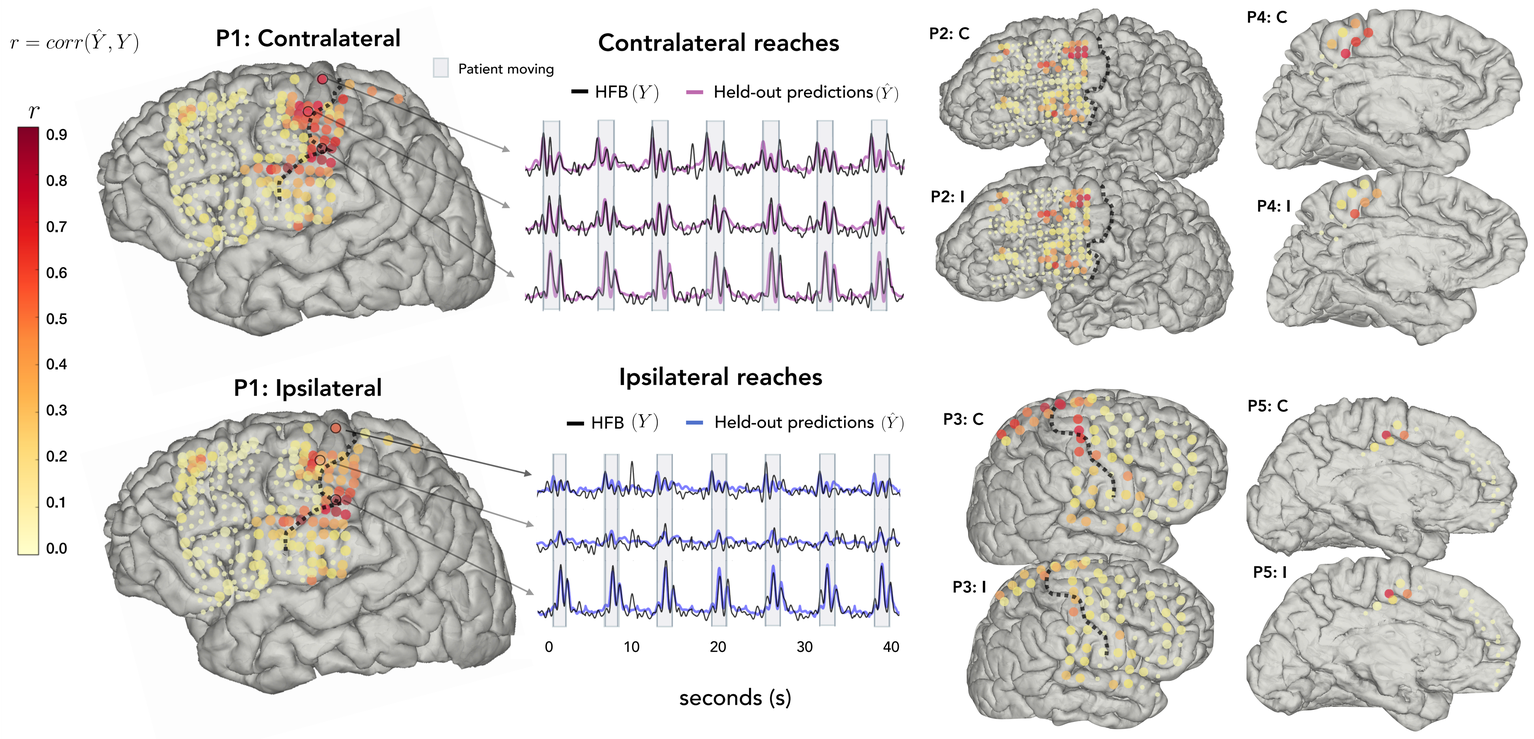
No generalization in non-human primates across the two upper limbs

Decoder trained on single units in M1

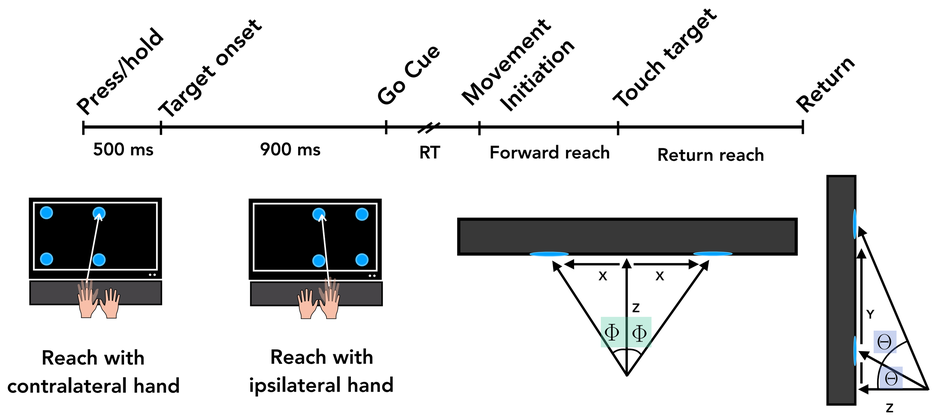


Ames & Churchland, 2018

Held-out prediction performance: Target model



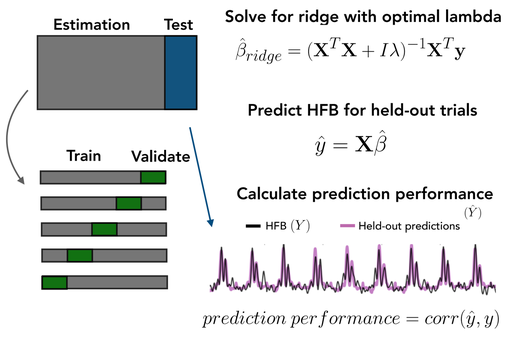
Instructed delay reaching task



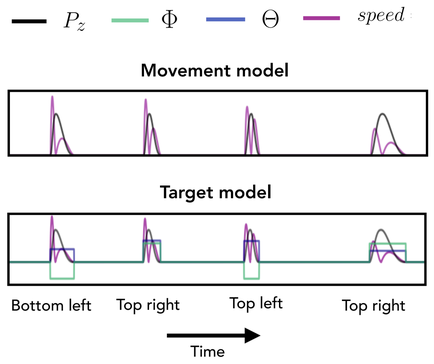
Kinematic encoding model: Ridge Regression

$\mathbf{X}$ = Time lagged kinematic features $\quad y$ = High frequency broadband (HFB) activity

Cross-validation



Model Comparison

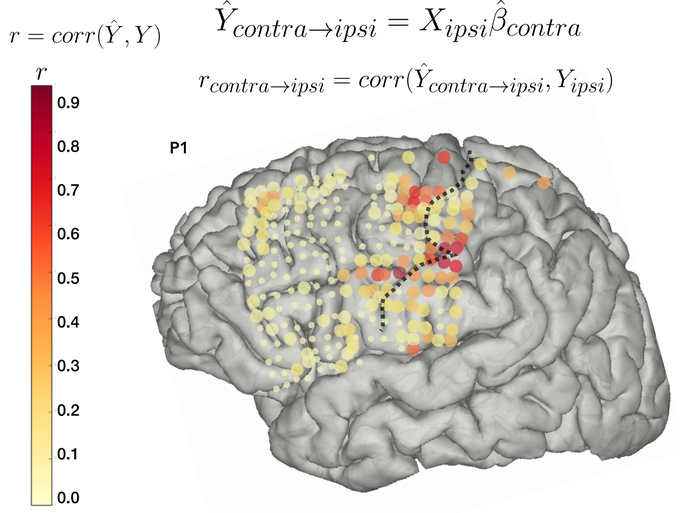


Are kinematics encoded the same across arms?

$r = corr(\hat{Y}, Y)$

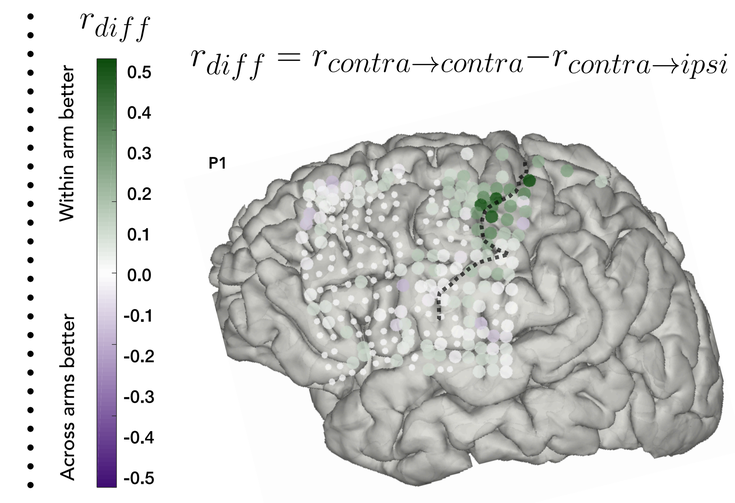
$\hat{Y}_{contra \to ipsi} = X_{ipsi}\hat{\beta}_{contra}$

$r_{contra \to ipsi} = corr(\hat{Y}_{contra \to ipsi}, Y_{ipsi})$

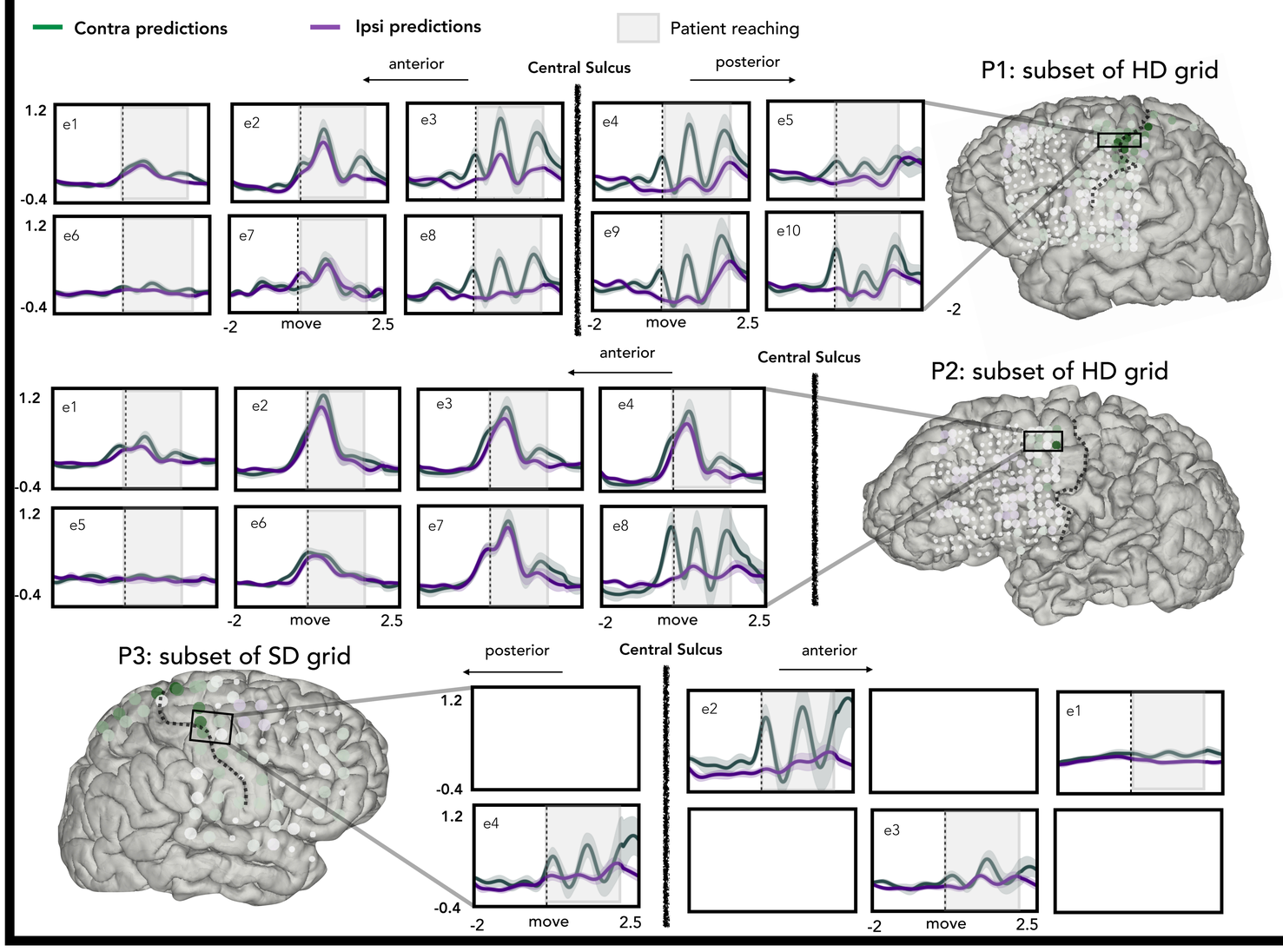


r_{diff}

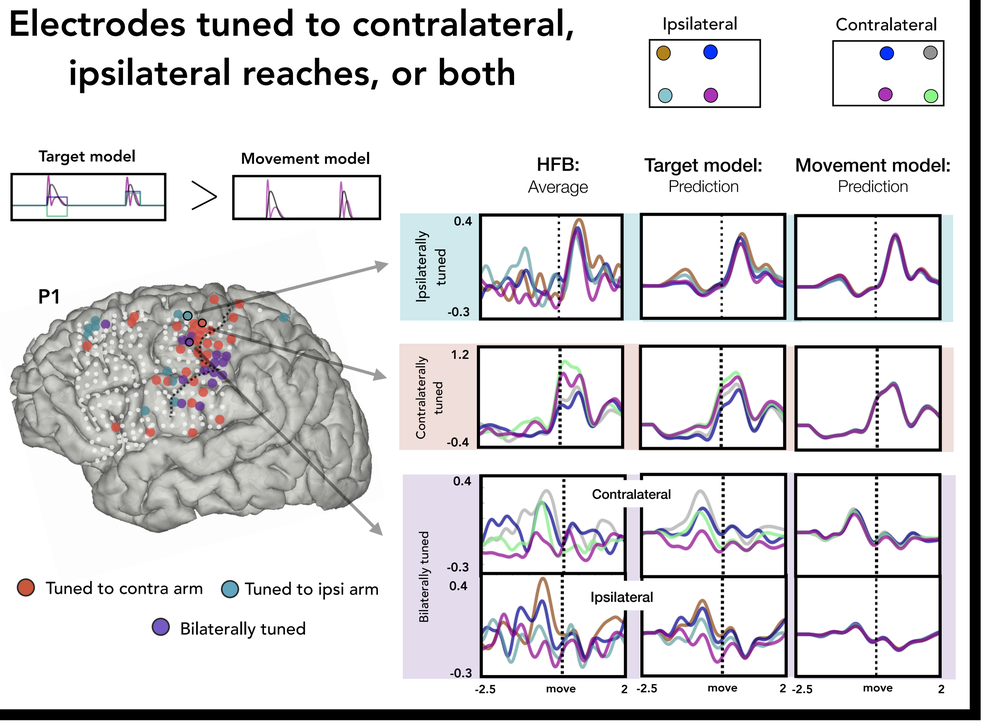
$r_{diff} = r_{contra \to contra} - r_{contra \to ipsi}$



Lack of generalization around central sulcus



Electrodes tuned to contralateral, ipsilateral reaches, or both



Acknowledgments and References

Thank you to Anwar Nunez-Elizalde for help with the encoding model.

National Institute of Neurological Disorders and Stroke

R01NS097480

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Conclusions

- Differences between the non-human primate studies and human ECoG studies may not be the level of resolution (spikes vs. HFB) but the location of the signal.
- Although some electrodes encode kinematics across the upper limbs in a similar fashion, electrodes near the central sulcus encode kinematics of the two limbs differentially.