Temporal dynamics of neural tuning to kinematics in primary motor cortex during reach-grasp-manipulation.

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Neural Control of Reaching & Grasping

In reach-to-grasp movements, reaching with the arm and grasping with the hand typically are thought to proceed concurrently. We recently found that when subjects reach to different locations to grasp and manipulate various objects, neural activity evolves over time, being related more to location early and object later. We now examine whether different combinations of linear models are better able to describe neural activity than one fixed, linear model.

Methods

- 12 kinematic features: the position and velocity of i) x/y/z of the wrist and ii) PC 1-3 of wrist and digit joint angles
- Models predict instantaneous firing rate from kinematics
- Fixed lag of 10 ms with firing rate scaling kinematics
- Data sampled at 20 equally spaced time points per trial from onset of movement to peripheral object contact (Median movement time = 235 ms for Monkey L and 235 ms for Monkey X)
- All R2 values calculated with 10-fold cross-validation

Linear Model

Global Linear Model

Time-Specific Linear Model

Mixture of Linear Regression Models

Conclusions

- A single linear model of neural encoding does a poor job of generalizing across the early and late phases of movement.
- A mixture of only 2 linear models performs as well as a collection of 20 time-specific linear models.

Acknowledgments

This work was supported by NINDS R01-NS070664, and K99-NS101127.