Project Proposal

Motivation

Many movement diseases can be casted as failures in timing during the planning of a movement. Understanding how the timing of actions is controlled before they reach the motor cortex is crucial in movement planning. Past experiments have suggested that medial pre-frontal cortex (dmPFC) is involved in the timing of actions and the top-down control of motor system in the motor cortex (MC). This process occurs by suppressing responses during movement delays.

Methods

Here we want to replicate the findings by Nandakumar et. al. [3] and Bekolay et. al. [2] using the nengo simulation system [1]. [3] describes neural activity in dmPFC and MC using time-series Principle Components Analysis (PCA) across neural populations. They then describe roles of delay-activity in dmPFC and motor cortex where they propose the top-down control model between both areas. [2] proposes model to simulate spikes using double-integrator network as a concrete mechanism that would replicate the results in [3].

Concretely, I'll use *nengo* [1], a Python library to simulate spikes trains, to simulate the model described in [2] which explains the results in [3].

Current status

I have already set up the software tools and simple experiments. I am currently requesting the experimental data from the authors in [3] and they have agreed to provide it.

References

[1] Trevor Bekolay, James Bergstra, Eric Hunsberger, Travis DeWolf, Terrence C Stewart, Daniel Rasmussen, Xuan Choo, Aaron Russell Voelker, and Chris Eliasmith. Nengo: a python tool for building large-scale functional brain models. *Frontiers in neuroinformatics*, 7, 2013.

[2] Trevor Bekolay, Mark Laubach, and Chris Eliasmith. A spiking neural integrator model of the adaptive control of action by the medial prefrontal cortex. *The Journal of Neuroscience*, 34(5):1892–1902, 2014.

[3] Nandakumar S Narayanan and Mark Laubach. Delay activity in rodent frontal cortex during a simple reaction time task. *Journal of neurophysiology*, 101(6):2859–2871, 2009.