B11

Roman Baravalle Advisor(s): Salvador Dura-Bernal

Analyzing behavior-related neural manifolds in a detailed model of motor cortex circuits

Several studies over the past decade strongly suggest the existence of low-dimensional latent dynamics in the primary motor cortex (M1) responsible for generating motor behaviors. Researchers have shown these latent dynamics are surprisingly consistent across individuals performing the same motor behavior. These latent dynamics result from the combined activity of individual neurons in M1. However, the specific cell types, cortical layers, and biophysical mechanisms underlying these dynamics remain largely unknown. We previously developed a realistic computational model of M1 circuits, including highly detailed corticospinal neurons models, which send motor commands to the spinal cord. We validated the M1 model against in vivo spiking and local field potential experimental data and demonstrated it can generate accurate predictions and help to understand brain disease.
In this work we aim to tune the M1 model to reproduce the specific neural manifolds associated with mouse in vivo recordings during a motor task. For this, we analyzed associations between low dimensional embedding of spiking patterns in M1 and behavioral outcomes in experiments on mice performing a single-target joystick reaching task. In this experiment, Neuropixels probes were implanted in mice M1 and ventrolateral (VL) thalamus. Both spiking patterns and trajectories were jointly analyzed to study whether the embeddings share or not commonalities, and a decoder was built. In this preliminary work, we evaluated different approaches to adapt the model output responses (firing patterns of selected subpopulations) to reproduce the experimental manifolds, including varying long-range inputs to a specific network instantiation, modifying circuit connectivity. By investigating the contribution of different cells (layer, class) to the decoder, we analyzed this scheme in the in-silico model and revealed the putative latent dynamics of the output responses.