firing patterns. Our findings, though mostly affecting intracellular dynamics, may have large knock-on effects on the nature of neural coding. Hitherto it has been thought that the neural code is optimised for energy minimisation, but this may be true only when neurons do not experience synaptic quiescence.

III-41. A dynamical model with E/I balance explains robustness to optogenetic stimulation in motor cortex

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Targeted optogenetic perturbations are key to investigating functional roles of sub-populations within neural circuits, yet their effects in recurrent networks may be difficult to interpret. Previous work has shown that optogenetic stimulation of excitatory cells in macaque motor cortex creates large perturbations of task-related activity, but has only subtle effects on ongoing or upcoming behavior, or the future dynamical evolution of neural population activity [O'Shea et al., Cosyne14]. fitting dynamical models to data, Duncker et al. [Cosyne17] have shown that this robustness is consistent with a local nonnormal dynamical system whose nullspace is well-aligned with the optogenetic perturbation pattern. Here, we ask how such alignment might arise. We hypothesize that circuit-level features such as E/I balance might contribute crucially. To evaluate this hypothesis from neural recordings, we develop a fitting approach to identify a high-dimensional discrete-time balanced E/I network that expresses the low-dimensional and smooth dynamics observed in the recorded population responses. We fit our model to neural data recorded on nonstimulated trials of a center-out reaching task, and study the E/I network responses to perturbations of the excitatory sub-population. The simulated E/I network is robust to these perturbations and its response patterns closely match those of recorded neural data on stimulation trials. This suggests that E/I balance in cortical circuits may offer an explanation for the robustness to optogenetic perturbations observed in motor cortex. Ultimately, developing more explicit links between circuit-level properties and population-level dynamics will lead to a better understanding of the effects of perturbations on cortical dynamics.

III-42. System identification in the brain: clustering dynamical rules from sensory data

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Sensory information reaches the brain in a stream of data exhibiting non-trivial temporal correlations. These correlations arise from multiple effects, from dynamical laws acting in the environment to non-trivial receptor response profiles. Detecting changes in the correlation structure of sensory signals can thus shed light on important changes in the dynamics of the environment, as well as on internal changes.

Here we present a biologically plausible neural network for clustering time-series data based on their dynamical structure. Our method starts with a circuit that keeps a running estimate of the autocorrelation. The activations