Neuron Hubs Distributed Differently in Deep Layers and Superficial Layers in Different Brain States

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What is the relationship between the structure of a cortical neural network and the its temporal activity patterns? Furthermore, due to the multi-layer structure of the cerebral cortex, does the superficial layer play different roles in this relationship when compared with deep layers? To answer these questions, we applied analysis on calcium imaging data taken from primary sensory cortex via a prism lens, which covers neurons from superficial and deep layers.

The structure of the cortical neural network is first addressed by the functional connectivity based on transfer entropy, which gives us directional weighted connections among all neurons, and the backbone connections are extracted using disparity filter; Moreover, the importance of each neuron in the network is evaluated by PageRank , which gives the importance value of each neuron based on its weighted input and output connections.

The temporal activity patterns that are driven by the same hidden states are inferred using a hidden Markov model. The number of states are determined by BIC criteria.

We applied the functional structure analysis using the neural data at different hidden states, and the results show the structure of the network differs in different brain states, and interestingly, the neuron hubs are distributed differently in deep layers and superficial layers in different brain states.

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