P-09

Study of Neural Connectivity Pattern via Persistent Homology

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Persistent homology is widely used in topological data analysis as it is effective in qualitative understanding of a network. More precisely, it can detect long-lasting (persistent) topological features within a weighted network through a nested sequence of simplicial complexes determined by the weights. Such persistent features contain robust mesoscopic connectivity information. Among the wide range of applications of persistent homology from natural image statistics[1] to material science, we are particularly interested in its usage in neuroscience. Taking a neuronal network of the somatosensory cortex of a rat (digitally reconstructed by the Blue Brain Project[2]) as a graph with neurons as nodes and their synaptic connections as edges, we adopt a graph-theoretic measure, local efficiency, as a weight parameter to create a filtration. In this *efficiency filtration*, each cortical neuron is weighted by its local efficiency value. We use this filtration to get layer-wise connectivity patterns in the structural organization of the neocortex divided into six layers, and then apply it to various models for comparison. This is a novel approach in a combining "classical" graph-theoretic measure with "recently" developed algebraic topological tool.

[1] G. Carlsson. Topology and Data, Bulletin of AMS, Vol. 46, 2 (2009)

[2] H. Markram et al. Reconstruction and Simulation of Neocortical Microcircuitry, Cell 163, 456-492 (2015)