Brent Doiron, University of Pittsburgh

Formation of neuronal assemblies and their maintenance during spontaneous cortical activity

The patterns of fluctuating spontaneous activity cortical neurons exhibit are related to the architecture in which they are embedded. This architecture may be modified by sensory experience, but the mechanisms that lead to the formation and persistence of structured connectivity in large recurrent networks are unclear. We demonstrate a network model that can be reorganized by stimuli through realistic plasticity and homeostatic mechanisms. Stimulus presentation leads to the formation of neuronal assemblies composed of neurons that receive common input. After training, spontaneous activity reflects prior evoked activity and stabilizes the learned network architecture. Sufficiently strong novel stimuli, however, can remap this architecture to reflect the new stimulus set. The model makes several predictions concerning the effect of sensory experience on spiking activity in spontaneous and evoked conditions. It also suggests that spontaneous activity fluctuations may consolidate learned connectivity patterns, rather than simply being a source of noise.