Ultraslow periodic sequences of neural population activity

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Abstract

The medial entorhinal cortex hosts many of the brain's circuit elements for spatial navigation and episodic memory, operations that require neural activity to be organized across long durations of experience. We have previously found that entorhinal cells can organize their activity into minute-scale oscillations that manifest as periodic sequences of activity in the neural population [1]. These ultraslow periodic sequences were recorded while mice ran at free pace on a rotating wheel in darkness, with no change in running direction and no scheduled rewards. It remains unknown, however, whether the sequences also occur during more naturalistic behaviours, for example while mice run in an open field arena. In this presentation I will show that in free foraging conditions, MEC neuronal activity can organize into sequences. However, the sequential activity is now characterized by resettings and interruptions. By developing a computational model, we investigate the conditions under which the sequences reset, as well as the repertoire of network architectures that can generate the ultraslow periodic sequences. We further illustrate the potential role of the sequences in facilitating, in downstream structures, patterns of neuronal activation that unfold at behavioural time scales.