TIFR Centre for Interdisciplinary Sciences
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Seminar

Long-term stability of behaviourally relevant dynamics in neural circuits

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Skills ranging from tying one's shoelaces to acing tennis serve require hundreds to thousands of hours of practice to master, but once perfected, can be retained for the long-term. However, we know little about the learning algorithms that transform the variable and imprecise actions of novices into the fluid, stereotyped movements of experts, nor how such algorithms are implemented in neural circuits. Addressing these questions requires high-resolution tracking of both behaviour and the activity of neuronal populations continuously over weeks and months. Such experiments face significant technical challenges, including processing vast amounts of neural and behavioural data.

I will present a low-cost, fully automated experimental platform that allows neural activity and behaviour to be recorded continuously over several months. The terabyte-sized datasets we generate are parsed using a novel processing pipeline in which the key step is a spike-sorting algorithm that can automatically identify and track single neuron activity in such recordings despite non-stationary of their spike-waveforms. I used our system to record activity of large populations of single neurons in motor circuits including the motor cortex and striatum, often tracking individual neurons for several weeks. In conjunction with the neural recordings, I acquired high-resolution behavioural data that was used to identify epochs of sleep, rest, grooming, feeding, and to track and quantify movement kinematics during execution of a skilled motor task. I found that average firing rates and correlation structure in neuronal populations were stable across many days, even as they varied across different behavioural states in a single day. Additionally, I found the motor representations of skilled behaviours to be remarkably stable at the single unit level, even over month-long timescales. These results demonstrate that neural circuits can maintain distinct task representations with long-term stability at the level of single neurons.

Friday, Mar 17th 2017

11:30 AM (Tea/Coffee at 11:15 AM)

Seminar Hall, TCIS