Contribution ID: **11** Type: **Long talk**

Mapping the world around us: A topology-preserved schema of space that supports goal-directed navigation

Thursday, July 6, 2023 11:00 AM (50 minutes)

Successful goal-directed navigation requires estimating one's current position in the environment, representing the future goal location, and maintaining a map that preserves the topological relationship between positions. In addition, we often need to implement similar navigational strategies in a continuously changing environment, thereby necessitating certain invariance in the underlying spatial maps. Previous research has identified neurons in the hippocampus and parahippocampal cortices that fire specifically when an animal visits a particular location, implying the presence of a spatial map in the brain. However, this map specifically encodes the current position but not the future goal location of an animal and is largely context-dependent, whereby changing the room or shape of the arena results in a new map orthogonal to the previous one. These observations raise the question, are there other spatial mapping systems in the brain that fulfil the cognitive requirements necessary for goal-directed navigation?
Using a goal-directed navigation task in an arena with multiple reward locations, we observed that neurons in the orbitofrontal cortex (OFC) exhibit distinct firing patterns depending on the animal's goal location, and this goal-specific OFC activity originates even before the onset of the journey. Further, the difference in the ensemble firing patterns representing two target locations is proportional to the distance between these locations in physical space, implying the preservation of spatial topology. Finally, carrying out the task across different spatial contexts revealed that the mapping of target locations in the OFC is largely preserved and that the maps formed in two different contexts occupy similar neural subspaces and could be aligned by a linear transformation. Taken together, the OFC forms a topology-preserved schema of spatial locations that is used to represent the future spatial goal. Our results point to the OFC as a potentially crucial brain region for planning context-invariant goal-directed navigational strategies.

Presenter: BASU, Raunak

Session Classification: Invited talk