INMED Conference Room
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The emergence of a compass information in the fly brain

The ability to navigate in a spatially extended environment is an essential function for species ranging from insects to mammals. If many interesting facts are known about the phenomenology of navigation, much less is understood about the neural mechanisms that support these abilities. Recent results from neural activity recordings in the fruit fly brain have identified a neural population that sustains an internal representation of heading direction. These neurons have dendrites arranged in a ring-shaped structure in the fly brain. At any time, the recorded dendritic activity is spatially localized on this ring with the activity bump tracking both rotations of surrounding visual landmarks as well as the fly's own rotational movements in the dark. Moreover, the activity persists in the absence of external stimuli, ie in the dark or in the absence of self-motion. This system provides an unprecedented opportunity to test theoretical models of persistent activity and information processing in neural networks. More precisely, I will show how one can model the dynamics of this bump of activity and provide hypothesis on the essential feature of a neural network that can explain the observed dynamics. With the help of computer simulations, we explore the main properties of the network and provide interesting predictions on the system. This study have potential applications for other living organisms. For instance neurons having similar properties, called head direction cells, have been characterized in mammals. However, due to experimental limitations in those organisms, it has been very challenging to come up with a network level understanding of the mechanisms generating those properties.