

## Examining the dynamic nature of neural representations with the olfactory system

Organisers:

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In the last few years rapid progress has been made in our understanding of olfactory information processing. The theoretical aspects of these advances not only have the potential to elucidate the mechanisms of olfaction but also to shed some light on neural information processing more broadly. Consequently, it seems timely to organise a focussed workshop to discuss these ideas. In particular, we will examine the dynamic phenomena at the core of olfactory information processing. For example, recent work (e.g., [1,2,3,4]) has begun to shed light on the nature of population rate codes. We will discuss the controversy over whether odours are represented as discrete dynamical states [1] or as smooth, but nonlinear, superposition of the responses to individual chemical components [2]. Other work has begun to elucidate the roles and mechanisms of stimulus evoked oscillations (e.g., [5,6]). In particular, we will discuss the possibility that stimulus specific transient synchrony between inhibitory neurons is important for coding odour identity and/or intensity. Lastly, work in *Drosophila* has demonstrated that inter-glomerular interactions serve to normalise the responses of component specific glomeruli in a divisive manner [7]. We will discuss the prospects of using these insights from the olfactory system to examine the dynamic action of divisive normalisation in the central nervous system in general.

The workshop is aimed at the many researchers working on the olfactory system but also is likely to attract a wider audience of theoreticians interested in core computational neuroscience topics such as stimulus evoked oscillations and non-linear rate dynamics. The workshop should also be of particular interest to all who are working with nonlinear dynamical systems theory.

Tentative list of speakers: M. Bazhenov, T. A. Cleland, R. Galan, D. Martinez, T Nowotny, M. Stopfer, U. Bhalla, G. Galizia, A. Khan, C. Linster, J. Niessing, A. Khan, G. Turner

### **References:**

- [1] Niessing et. al., Olfactory pattern classification by discrete neuronal network states. *Nature*, 2010.
- [2] Khan et. al., Odor Representations in the Rat Olfactory Bulb Change Smoothly with Morphing Stimuli. *Neuron*, 2011
- [3] Roberto F. Galán et. al., Sensory memory for odors is encoded in spontaneous correlated activity between olfactory glomeruli. *Neural Computation*, 2006.
- [4] C. L. Buckley and T. Nowotny. Multi-scale Model of an Inhibitory Network Shows Optimal Properties near Bifurcation, *Physical Review Letters*, 2011.
- [5] Ito, I, et. al., Frequency transitions in odor-evoked neural oscillations. *Neuron*, 2009.
- [6] Assisi C et al., Using the structure of inhibitory networks to unravel mechanisms of spatiotemporal patterning. *Neuron*, 2011.
- [7] Olsen et. al., Divisive Normalization in Olfactory Population Codes, *Neuron*, 2010