LABORATORY OF COMPUTATIONAL NEUROSCIENCE (LCN)

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11h00, Room SV 2615

Computational Neuroscience Seminar

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Roles, connectivity and plasticity of interneurons in the olfactory bulb

Stimulus encoding by primary sensory brain areas provides a data-rich context for understanding the underlying circuit mechanisms. The vertebrate olfactory bulb is one such area having unusual two-layer dendro-dendritic connections. The roles of these feed-forward and feed-back inhibitory connections in odor coding are unclear. To probe these roles, I will present a detailed compartmental model of microcircuits in the rat olfactory bulb, built with Prof Upinder Bhalla (NCBS), that synthesizes a wide range of experimental observations on bulbar physiology and response dynamics.

From our model, we predict sparse, long-range, asymmetrical and differential inhibition between bulbar principal neurons (mitral cells). This inhibition is mediated by action potentials propagating along the lateral dendrites of mitral cells and activating deep-layer feed-back inhibitory interneurons (granule cells). These connections are sufficient and possibly necessary to decorrelate the respiratory-phases of odor responses of mitral cells that receive similar input, as observed (Dhawale, et al. 2010). To replicate observed linear summation of odor responses (Gupta and Bhalla, in revision), we predict that superficial layer feed-forward interneurons (periglomerular cells) linearize the mitral cell input-output transformation, unlike previous models of contrast enhancement.

Further, I will discuss ongoing efforts to simplify the model and to predict the plasticity rules that could generate the inhibitory connectivity between mitral cells proposed above. I will conclude by presenting my future directions for studying inhibitory plasticity in relation to cortical function.