

The classification problem in the olfactory system of insects

Ramón Huerta^{1,2}

¹ Institute for Nonlinear Science, University of California at San Diego La Jolla CA 92093-0402 USA

The task of odor classification has several different aspects. On the one hand some similar odor receptions need to be classified as the same odor whereas on the other hand distinct odors have to be discriminated from each other. In addition some quite different odors might have the same *meaning* and therefore need to be *associated* with each other. The main question is how the olfactory system accomplishes these quite different tasks with the available natural *technology*. There are three known stages of neural processing of odor information before classification: *Data collection* from the sensors in the antenna, *information compression* and *temporal decorrelation* by the antennal lobe, and *nonlinear projection/expansion* to the intrinsic Kenyon cells (KC) of the mushroom body. These three stages have been extensively studied and a good understanding of many aspects has been achieved. We propose a theory of odor classification that relies on a large screen space, random connectivity, Hebbian plasticity and mutual inhibition. We show that these are necessary and *sufficient* elements to accomplish the classification tasks described above.