Odor Information Processing in Human - Oscillatory Model

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Our goal is to simulate the dynamic behavior of the olfactory bulb as part of the olfactory system in order to study how the olfactory neural system processes the odorant molecular information. We have based our model on coupled nonlinear oscillators, which resemble groups of mitral and granule cells as main building units. Odors evoke oscillatory activity in populations of excitatory and inhibitory cells of the proposed two-layer architecture with feedforward and feedback connections between them, and the system exhibits odor-specific adaptation. The output of a unit, representing the average firing rate within the corresponding population, is modeled as a sigmoidal function of the synaptic input. The system exhibits complex oscillatory behavior, simulating mammalian olfactory bulb. Simulations show that the dynamic behavior of the model is stable under the influence of noise. It is shown that the simulations depend on anatomical and physiological estimates of synaptic densities, coupling symmetries, synaptic gain, dendritic time constants, and axonal delays. The output pattern is not just a combination of on/off units, rather it is an array of amplitude oscillations and thus is a result of influences from all of the units. The model is able to reduce noise, allowing the pattern to emerge from incomplete and noisy input.