Summary

The olfactory bulb and the antennal lobes are the olfactory neuropils of vertebrates and insects. Here, odors are encoded as spatio-temporal patterns of neural activity. The relation between these patterns and the actual odor perception remains enigmatic. Additionally, whether and how this relation changes with the odor concentration is far from being fully understood.

In this thesis I investigated these questions using the honeybee antennal lobe as model system. I selectively stained the output neurons of the antennal lobe, the so called projection neurons. Using calcium imaging techniques I measured changes in their activity evoked by a set of 16 different odorants presented at four concentrations. In order to be able to quickly and comfortably evaluate the large amount of data I gathered during this experiment, I designed and implemented a complete computer program for data evaluation.

When analyzing the data I find that: 1) Chemically similar odors evoke similar patterns of projection neuron activity in the honeybee antennal lobe. 2) Increasing odor concentrations lead to an overall but non-linear increase in projection neuron activity. 3) The relative similarity between odor representations remains unchanged across concentrations. 4) In the antennal lobe, projection neuron activity separates odors according to their chemical properties, irrespective of the odor concentrations. 5) The similarity between odor representations in the antennal lobe is predictive for the perceived odor similarity. And 6) this information is redundantly encoded in the glomerular activity of the honeybee antennal lobe.