

Analysis of an Insect's Olfactory Receptor Neuron Response by NMF Method for Odor Approximation

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(Received September 30, 2013; accepted December 18, 2013)

Key words: odor, olfaction, nonnegative matrix factorization (NMF) method, insect, odor approximation

Odor approximation to express a variety of odors using a small number of odor components is important. Our group has for years been studying odor approximation to express a variety of odors using a small number of odor components. Basis vectors corresponding to odor components can be extracted from an established database by the nonnegative matrix factorization (NMF) method. We have built a database of several hundred types of essential oil using mass spectrometry (MS). We have already reported that the approximated odors of essential oils can be reproduced by blending odor components. However, it is expected that the approximation in biological space provides higher accuracy. It is necessary to compare mass-spectrum data space with the biological space. In this study, we also used the NMF method to analyze the biological sensing space on the basis of insects' response data. Odor chemicals should be located spatially as characterized by 24 olfactory receptor neuron (ORN) responses. When chemical structures are much different, the distance between them is long. We found that the extracted basis vectors were located according to the spatial distribution of odors. Analysis of the relationship between the number of basis vectors and the residual of the NMF method revealed that a larger number of basis vectors results in a smaller residual. In the experiment of approximating 9 fruit scents, we tried to approximate the ORN responses to target odor by using 10 extracted basis vectors. We found that a larger number of basis vectors results in a higher correlation coefficient.

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