

# Statistical analysis for clustering of areas on the olfactory bulb and estimation of the physico-chemical properties detected by glomeruli in each area

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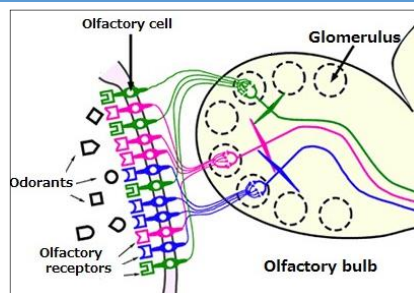
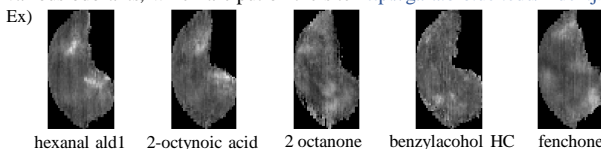
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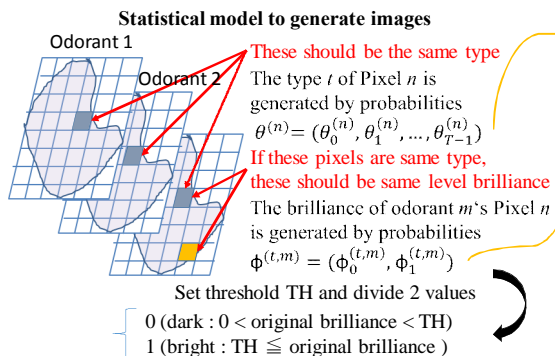
- ~ Glomerular layer of the olfactory bulb to activity by odorants.
- ~ A glomerulus in a particular location of the glomerular layer in the olfactory bulb detects particular physico-chemical properties.
- ~ Some researchers have clarified this correspondence between physico-chemical properties and locations in the glomerular layer. However, properties or areas in the glomerular layer they clarified were coarse.

The aim : to clarify this correspondence by only statistically analyzing the activation pattern images of the glomerular layer in the rat olfactory bulb for various odorants, which are put on the site <http://gara.bio.uci.edu/index.jsp>.



These are called  $\delta$ Odorant mapö

Methods



Prior distribution of  $\theta^{(n)}$  : Dirichlet distribution with parameter  $c$   
Prior distribution of  $\phi^{(t,m)}$  : Dirichlet distribution with parameter  $f$

Estimate  $\theta$  and  $\phi$  by Gibbs sampling [1]

**Estimation of Physico-chemical Properties Detected by Glomeruli in each Area**

$\phi_0^{(t,m)}$  is large  $\rightarrow$  type  $t$  has **not** reacted to odorant  $m$   
 $\phi_1^{(t,m)}$  is large  $\rightarrow$  type  $t$  has reacted to odorant  $m$

whether type  $t$  has reacted to odorant  $m$  or not (1 or 0)  
whether odorant  $m$  has a certain Physico-chemical or not (1 or 0)

Correlation coefficient

Experiment

Conditions for the experiment

- ~ Sampling : 492 Odorant map which are put on the site <http://gara.bio.uci.edu/index.jsp>.
- ~ Number of types : 40 (1 of them is background of images).
- ~ Physico-chemical properties : 16 Odorant Properties (ex. molecular length, water solubility, etc) and 47 Chemical Classifiers.

Results & Conclusion

Ex) type4

$\phi_0^{(4,1)} \geq 0.9$	$\phi_1^{(4,1)}$	Alicyclic	Alkane	...
$\phi_0^{(4,2)} \geq 0.9$	$\phi_1^{(4,2)}$	0	0	1
$\phi_0^{(4,3)} \geq 0.9$	$\phi_1^{(4,3)}$	1	1	0
$\phi_0^{(4,3)} \leq 0.9$	$\phi_1^{(4,3)}$	*	*	*
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$\phi_0^{(4,m)} \geq 0.9$	$\phi_1^{(4,m)}$	0	1	0
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$\phi_0^{(4,492)} \geq 0.9$	$\phi_1^{(4,492)}$	1	1	0

This correlation coefficient is the highest

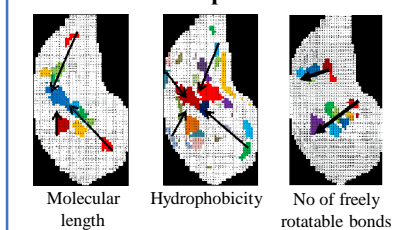
**Chemical Classifiers**

Aliphatic or alicyclic hydrocarbon    Small aliphatic ester (8C or less)    Aliphatic ester (not alicyclic)    Polycyclic    Carboxylic acid

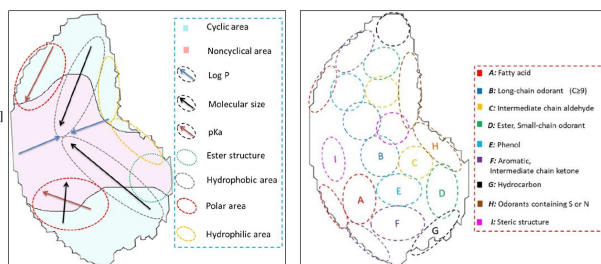
Small aliphatic aldehyde (8C or less)    Primary alcohol    Large aliphatic ester (9C or more)    Large aliphatic aldehyde (9C or more)    Large aliphatic ketone (9C or more)    Small carboxylic acid (5C or less)    Large carboxylic acid (6C or more)

Ketone    Alkylbenzene    Aromatic with O-containing substituent    Aromatic    Heterocyclic with N in ring    None

**Odorant Properties**



Estimation of another research [2]



~ There is also a portion of the match with another research results.

~ Estimation using Chemical Classifiers is coarse and there are some types those detect gaps of each image.

**Problem to be solved** : To correct gaps of each image and considering combination of Chemical Classifiers or Polar functional groups.

References & Acknowledgement

[1] T. L. Griffiths and M. Steyvers,  $\delta$ Finding scientific topicsö, Proceedings of the National Academy of Sciences of the United States of America, vol.101 Suppl 1, pp. 5228-35 (2004)  
[2] Imabashi Masahiro,  $\delta$ Study on the smell clustering system using the molecular recognition nano filterö, doctoral thesis of Graduate School of Information Science and Electrical Engineering, Kyushu University (2014)