Report 15-11-2018

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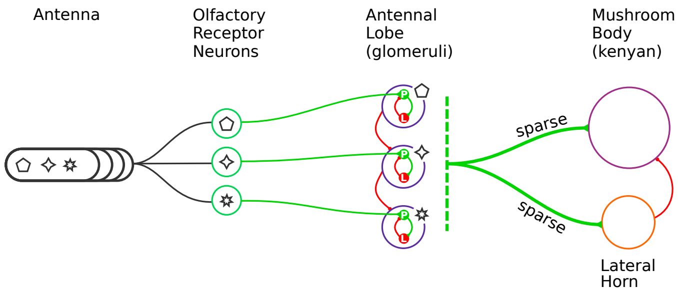
I arrived to the group on the 15th of November 2018; I've been settling in. I almost have a fully working desktop computer (21-11-2018)!

The objective is to make use of the BrainScaleS neuromorphic platform to do object recognition. For this we will pursue odour identification taking inspiration from insect neural anatomy.

1 Background reading

1.1 Layman's introduction

I read the Wikipedia entry on insect olfaction as a layman's introduction to the subject. It mainly explains the structure of the olfactory pathway of an insect's nervous system.



Is some topological order kept through different layers? This could allow us to introduce distance-dependent connectivity rules.

I've started reading papers suggested by Mario Pannunzi:

1.2 Odor plumes and how insects use them

The authors describe the complexity of odour plumes and present a review of models. There are 3 different aspects to the full plume structure model:

- Large scale. This deals with the shape and odour strength (average). Many models have been suggested for the direction aspect of the shape ranging from linear to wave-like. Average strength is usually modelled as having an exponential decay with respect to distance. Insects use this aspect to orient themselves while finding the source.

- Small scale. Odour concentration fluctuation; affects insect instantaneous response. Since the medium is turbulent, concentration changes along the plume. Furthermore, insects' behaviour is modified depending on how dense the odour is (e.g. attraction vs. repulsion).
- Time-average. How likely is an insect to smell the source.

In summary, odour perception is a complex problem as the signal is propagated through a medium (wind) which is usually turbulent. The signal is thus unreliable and the medium does not commonly indicate the source's direction. Nonetheless, insects are able to locate stimuli emitters and react.

Are we skipping this part in the simulation? We just assume antennas received a concentration X of odour Y?

1.3 Learning pattern recognition and decision making in the insect brain

2 Using BrainScaleS

Most required documentation can be found at HBP Neuromorphic platforms guidebook [1]

2.1 Registration to HBP portal

To use the system remotely as a "standard" remote user we must first register to the HBP Collaboratory via invitation (from a member or sending an intention letter).

After this, one must sign and email back the HBP Platform User Agreement [2] Once access has been granted the platform provides test Jupyter Notebooks for the different neuromorphic systems. Collab requires user to authorize the "Neuromorphic Computing Platform" to access info in browser so that sub-systems work correctly.

2.2 Creating and submitting jobs

Jobs are coded using PyNN and can be submitted through the browser or a Python web API. Creating a Collab is done through a Jupyter-like form (it

[1] https://electronicvisions.github.io/hbp-sp9-guidebook/pm/using_pm_newflow.html

[2] https://www.hbpneuromorphic.eu/UserAgreement_HBPNeuromorphicComputingPlatform.pdf

does not automatically redirect to the newly-created Collab!) Installing the web API can be done through pip (requires web access) or setuptools (after downloading the project file).

Access to different levels of usage of servers can be obtained by submitting a form explaining the intended use of the resources.

Since the PyNN API version 0.7 (can be obtained through Github [3] or PyPi [4]) is used to interact with the BrainScaleS platform, Python 2.7 is required.

[3] https://github.com/NeuralEnsemble/PyNN/releases/tag/0.7.5

[4] https://pypi.org/project/PyNN/0.7.5/