

Poster presentation

Open Access

Learning cortical representations from multiple whisker inputs

Stuart P Wilson*¹, Ben Mitchinson¹, Martin Pearson², James A Bednar³ and Tony J Prescott¹

Address: ¹Department of Psychology, University of Sheffield, Sheffield, UK, ²Bristol Robotics Laboratory, Bristol, UK and ³School of Informatics, University of Edinburgh, Edinburgh, UK

Email: Stuart P Wilson* - s.p.wilson@sheffield.ac.uk

* Corresponding author

from Eighteenth Annual Computational Neuroscience Meeting: CNS*2009
Berlin, Germany. 18–23 July 2009

Published: 13 July 2009

BMC Neuroscience 2009, **10**(Suppl 1):P334 doi:10.1186/1471-2202-10-S1-P334

This abstract is available from: <http://www.biomedcentral.com/1471-2202/10/S1/P334>

© 2009 Wilson et al; licensee BioMed Central Ltd.

Rats' whiskers convey tactile information to the somato-sensory cortex, where layer 4 neurons are clustered into barrels, each responding primarily to input from one principal whisker (PW). The spatial arrangement of the barrels reflects the spatial arrangement of the whiskers on the animal's snout, thus representing the whiskers in a somatotopic map. Within a barrel, neurons are selective for the direction in which the PW is deflected, and across layer 2/3 directions may be organized into a pinwheel map such that deflection of whisker A towards whisker B activates barrel field A neurons located closest to barrel field B [1] (Figure 1c). More recently layer 5 neurons have been

found to be selective for the direction in which waves of sequential deflections are applied across multiple whiskers, although the potential spatial organization of a map for these stimuli has not yet been determined [2].

In previous work [3] we have shown how single whisker direction maps can emerge from a LISSOM (laterally interconnected synergetically self-organizing map [4]) model of layer 2/3 barrel cortex, when the directions of waves of multi whisker input are correlated with the directions of the individual whiskers. Here we investigate the emergence and organization of multi whisker representations in an additional sheet of layer 5 neurons. Self organization of this system is driven by signals measured from an array of simulated whiskers, however, work is currently in progress to generate training data from an array of physical composite glass fiber whiskers (Figure 1b) mounted on an XY translation table.

The hardware based approach allows us to investigate how cortical representations for temporal features such as stimulus onset/offset, velocity and frequency might be integrated with those for the spatial components of whisker stimuli, and should enable us to predict receptive field properties of layer 5 cells that may be measurable in future *in vivo* experiments.

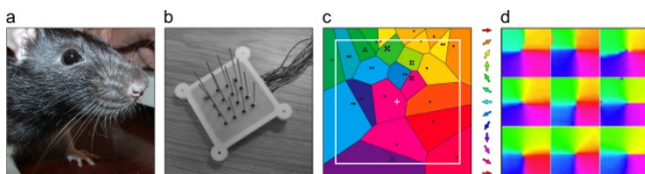


Figure 1
The development of a physical model of the rat whisker system (a). A prototype of the sensor system from which we can measure realistic whisker stimulus interactions is shown in (b). A somatotopic map for whisker direction measured across the horizontal extent of one layer 2/3 barrel field [1] is reproduced from [1] and shown in (c). (d) A layer 2/3 map that emerges in nine simulated barrel fields based on multi whisker inputs [3].

References

1. Andermann ML, Moore CI: **A somatotopic map of vibrissa motion direction within a barrel column.** *Nat Neurosci* 2006, **9**:543-551.
2. Jacob V, Le Cam J, Ego-Stengel V, Schulz DE: **Emergent properties of tactile scenes selectively activate barrel cortex neurons.** *Neuron* 2008, **60**:1112-1125.
3. Wilson SP: *Self-organisation can explain the mapping of angular whisker deflections in the barrel cortex* MSc thesis, The University of Edinburgh, UK; 2007.
4. Miikkulainen R, Bednar JA, Choe Y, Sirosh J: *Computational maps in the visual cortex* Berlin: Springer; 2005.

Publish with **BioMed Central** and every scientist can read your work free of charge

"BioMed Central will be the most significant development for disseminating the results of biomedical research in our lifetime."

Sir Paul Nurse, Cancer Research UK

Your research papers will be:

- available free of charge to the entire biomedical community
- peer reviewed and published immediately upon acceptance
- cited in PubMed and archived on PubMed Central
- yours — you keep the copyright

Submit your manuscript here:
http://www.biomedcentral.com/info/publishing_adv.asp

