

# Experimenting the variational definition of neural map computation

Olivier Rochel, Pierre Kornprobst, Thierry Vieville

► **To cite this version:**

Olivier Rochel, Pierre Kornprobst, Thierry Vieville. Experimenting the variational definition of neural map computation. Sixteenth Annual Computational Neuroscience Meeting: CNS2007, Jul 2007, Toronto, Canada. 8 (Suppl 2), pp.P179, 2007, BMC Neuroscience. <hal-00784473>

**HAL Id: hal-00784473**

**<https://hal.inria.fr/hal-00784473>**

Submitted on 4 Feb 2013

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Poster presentation

## Experimenting the variational definition of neural map computation

Olivier Rochel\*, Pierre Kornprobst and Thierry Vieville

Address: Odyssee Lab, INRIA Sophia-Antipolis, France

Email: Olivier Rochel\* - Olivier.Rochel@sophia.inria.fr

\* Corresponding author

from Sixteenth Annual Computational Neuroscience Meeting: CNS\*2007  
Toronto, Canada. 7–12 July 2007

Published: 6 July 2007

BMC Neuroscience 2007, 8(Suppl 2):P179 doi:10.1186/1471-2202-8-S2-P179

© 2007 Rochel et al; licensee BioMed Central Ltd.

### Variational formulation to spiking neural networks: A top-down approach

We bring new insights to better understand the link between spiking neural networks and variational approaches. To do so, we consider two simple visual tasks formulated as variational approaches, related to linear/non-linear filtering [1] and input selection: Image denoising via edge-preserving smoothing, and focus of attention via a winner-take-all mechanism. Variational approaches, which refer to an energy minimization formulation, are defined in a continuous setting. Our goal is to show how spiking neural networks can be used to minimize those energies. Based on some recent advances [2,3], including spiking neurons [4], the key point is to understand the relation between smoothness constraints and cortical activity diffusion (as observed with extrinsic optical imaging). In particular, we will focus on the two following issues:

#### Diffusion

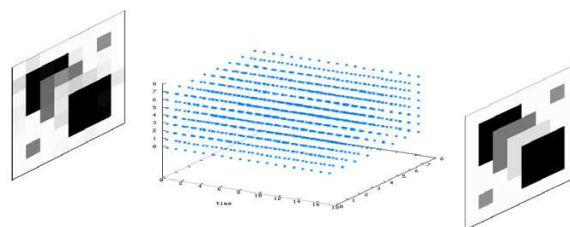
Depending on the task, and given the underlying neural circuitry and computational power, how far, and how fast should local information be transmitted (e.g., intensity, local gradient, local movement)?

#### Feedback

How can different information pathways, associated with different processing tasks, interact?

### Results and discussion

Input images, encoded by means of a simple latency code, are processed by a network of spiking neurons generated from the variational description of the task. A simple temporal coding scheme is used in this initial study, the underlying idea being to analyze the possible role of synchrony as a support for diffusing information [5]. A step further, this relates to more general forms of computation in the brain, in terms of propagation of information, neural coding. It has also been linked [3] to modulation of a feed-forward processing track by various feedback mechanisms.



**Figure 1**

Image denoising by a spiking neural network with local interactions (nearest neighbors).

## Acknowledgements

This work was partially supported by the EC IP project FP6-015879, FAC-ETS.

## References

1. Aubert G, Kornprobst P: **Mathematical problems in image processing: partial differential equations and the calculus of variations.** In *Applied Mathematical Sciences Volume 147*. Springer-Verlag; 2006.
2. Cottet G-H, El Ayyadi M: **Volterra type model for image processing.** *IEEE transactions on image processing* 1998:7.
3. Viéville T, Kornprobst P: **Modeling cortical maps with feedbacks.** *Int Joint Conf on Neural Networks* 2006.
4. Kornprobst P, Chemla S, Rochel O, Viéville T: **A 1st step towards an abstract view of computation in spiking neural networks.** in *Proc NeuroComp* 2006.
5. Singer W: **Neuronal synchrony: a versatile code for the definition of relations?** *Neuron* 1998, 24:49-65.

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](http://www.biomedcentral.com/info/publishing_adv.asp)

