

Cortically-inspired Computational Models for Multimodality

Thomas Girod, Mathieu Lefort, Jean-Charles Quinton

▶ To cite this version:

Thomas Girod, Mathieu Lefort, Jean-Charles Quinton. Cortically-inspired Computational Models for Multimodality. 3rd EUCogII Members' Conference, Oct 2010, Palma de Mallorca, Spain. inria-00536869

HAL Id: inria-00536869 https://inria.hal.science/inria-00536869v1

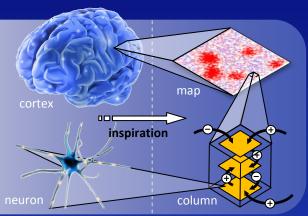
Submitted on 17 Nov 2010

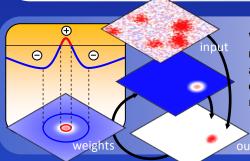
HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire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

Cortically-inspired Computational Models for Multimodality

Dynamic Neural Fields

In the field of computational neuroscience, we develop **distributed models** of the cortex to account for perceptual and sensorimotor capabilities. Adopting a **mesoscopic level of modeling** with dynamic neural fields representing topologically organized populations of **cortical columns**, we propose various learning rules, competition mechanisms and interconnection schemes. Under the right conditions, these allow the **emergence of spatially coherent bumps** of activity yielding attentional properties and high robustness to noise.



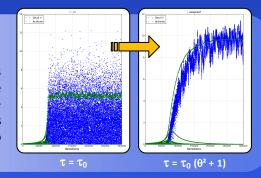


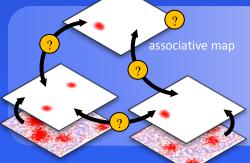
We focus in this poster on the distributed, continuous and unsupervised learning of multi-sensory representations and sensorimotor behaviors. For localized bumps of activity to emerge on cortical maps when coherent stimuli are presented, adequate competition mechanisms such as the CNFT (Continuous Neural Field Theory) are required. Nearby units can thus become selective to similar stimuli and self-organize.

Competition & Self-organization

BCM Learning Rule

The BCM theory uses a **bio-plausible learning rule** for assemblies of neurons to become selective to specific stimuli. With the standard formulation of the rule, the lower the probability of a stimulus, the harder it is to become selective to it. This is problematic in a multimodal context, as it often leads to the dominance of one modality. **Adaptive parameters** are introduced **to improve stability and speed up convergence**.





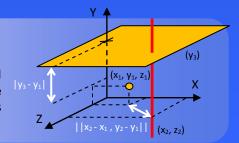
The nature of multimodal representations depends on the number of maps used and their interconnections. Different modalities can either be directly merged as a single sensory flow or directed to a set of unimodal maps later combined in associative maps. Interactions may directly modulate the activity, dynamics or learning rules, on which the emergence of distributed coherent representations depends.

unimodal maps and inputs

Interconnection Schemes

Computational Abstraction

In order to speed up the computations and alleviate the 2D constraints of cortical sheets, the regular mesh generally considered can be replaced by **discrete interacting points**. The resulting topology lacks the flexibility of self-organizing maps but allows the manipulation of an **arbitrary and variable number of dimensions**.





Thomas Girod, Mathieu Lefort, Jean-Charles Quinton CORTEX Project – LORIA/INRIA (cortex.loria.fr) 615 rue du Jardin Botanique 54600 Villers-lès-Nancy France

