



Workshop on Mathematical Models of Cognitive Architectures



CIRM, Marseille, December 5-9, 2011

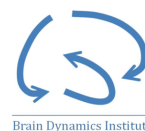
Organized by Viktor Jirsa & Gustavo Deco

The quickly growing complexity of the modern information society confronts us with the task to select valuable and reasonable information from a bigger and bigger avalanche of complex and highly diverse data, as becomes evident from imaging processing in multimedia applications, human machine interface, surveillance, mobile communication and the internet, just to mention a few examples. On the one hand the rapid development and ubiquity of modern information technology provides us with an increasing quantity and complexity of data, but on the other hand the burden of selecting and evaluating valuable information in an adapted and reasonable way is to date still put on the user. One major reason for this imbalance relates to the fact that the selection of useful information represents an intrinsically difficult task: it requires the ability of a system to adaptively reduce the complexity of the data, to generate meaning from it and to flexibly assess the putative value of this meaning given the present and past status of the environment. In other words, it must be capable of active and intelligent perception, reasoning, planning and decision making: it must have human cognitive abilities.

Mathematical neurocognitive models of brain function are based on the techniques of computational and integrative neuroscience. The neurodynamical approach models the mutual interaction of multiple hierarchical brain areas and include biological details from the levels of synaptic and neural spiking dynamical mechanisms up to the level of global brain activation and behavior. By this, we are able to describe neuronal brain activity both at the local and global level. Neurocognitive models can and will be constrained by comparing quantitative results and predictions with experiments from various sources and at various levels including neuroanatomy (structural information), cellular electrophysiology (microscopic level), functional brain imaging (mesoscopic level) and psychophysics (macroscopic behavioural level). The requirement to simultaneously explain results generated from experiments of different designs, which address different aspects of human cognition and produce data at different neuroscientific levels will ensure both sufficiently strong constrains of the models and their proximity to the biological counterpart, the human brain. Biologically plausible neurodynamical modeling of cognitive phenomena will be referred to as neurocognitive modeling.

Our workshop Mathematical Models of Cognitive Architectures gathers renowned scientists from theoretical and experimental domains of neuroscience with the goal to animate the discussion towards the development of mathematical models of cognitive functioning. The workshop will be held co-jointly with the annual meeting **Brainmodes**, which seeks to explore innovative means of understanding complex brain activity and multimodal neuroscience data sets.

SUPPORTED BY





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SUNDAY 4/12/2011 Arrival and check-in

MONDAY 5/12/2011

MORNING SESSION

- 9:00 – 10:00** MICHAEL BREAKSPEAR - *Unravelling rope: Fractional diffusion whilst viewing Alfred Hitchcock*
- 10:00 – 11:00** SUE DENHAM - *Auditory scene analysis: a competition between auditory proto-objects?*
- 11:00 – 11:30** **COFFEE BREAK**
- 11:30 – 12:30** JULIEN LAGARDE - *Coordination Dynamics of Multisensory Integration*
- 12:30 – 14:00** **LUNCH**

AFTERNOON SESSION

- 14:00 – 15:00** MISHA TSODYKS - *Modeling associative recall from long-term memory*
- 15:00 – 16:00** XIAO JING WANG - *What determines the time scales of large-scale brain circuit dynamics?*
- 16:00 – 16:30** **COFFEE BREAK**
- 16:30 – 17:30** EDWARD LARGE - *A Universal 'Grammar' for Music*
- 17:30 – 18:30** JENS STARKE - *Bifurcation analysis when no equations are available*

TUESDAY 6/12/2011

MORNING SESSION

- 9:00 – 10:00** STÉPHANE VIOLLET - *Optic flow sensors and optic flow based autopilots*
- 10:00 – 11:00** TJEERD BOONSTRA - *Noise driven oscillations: A computational model of bimanual tapping*
- 11:00 – 11:30** **COFFEE BREAK**
- 11:30 – 12:30** STEFAN KIEBEL - *Recognizing recurrent neural networks: Bayesian inference for recurrent neural networks*

12:30 – 14:00 **LUNCH**

AFTERNOON SESSION

- 14:00 – 15:00** GREGOR SCHÖNER – *Dynamic Field Theory as a Framework for Neurally Grounded Cognitive Architectures*
- 15:00 – 16:00** RAOUL HUYS - *Structured Flows on Manifolds: concepts, tools, and applications to motor timing and control*
- 16:00 – 16:30** **COFFEE BREAK**
- 16:30 – 17:30** CHRISTOPH VON DER MALSBERG - *A Generic Data Structure to Absorb Cognitive Stuff*
- 17:30 – 18:30** FELIX SCHÜRMAN – *Blue Brain Project - Unifying Models in Neuroscience*



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WEDNESDAY 7/12/2011

MORNING SESSION

- 9:00 – 10:00** **WOLFRAM ERLHAGEN** - *A dynamic neural field architecture for natural human-robot interactions*
- 10:00 – 11:00** **MAX RIESENHUBER** – *Computational mechanisms of object recognition in cortex: from pipelines to flying crossbodies*
- 11:00 – 11:30** **COFFEE BREAK**
- 11:30 – 12:30** **JOHN REYNOLDS** - *Neural mechanisms of visual attention*
- 12:30 – 14:00** **LUNCH**

AFTERNOON SESSION

- 14:00 – 15:00** **KARL FRISTON** - *Active inference, free energy and the Bayesian brain*
- 15:00 – 16:00** **GUSTAVO DECO** - *Ongoing cortical activity at rest: The global attractor structure of the brain*
- 16:00 – 16:30** **COFFEE BREAK**
- 16:30 – 17:30** **STEVEN GROSSBERG** - *The Predictive Brain: Autonomous Learning, Recognition, Cognition, and Navigation in a Changing World*

THURSDAY 8/12/2011

MORNING SESSION

- 9:00 – 10:00** **RENÉ DOURSAT** - *Morphogenetic "neuron flocking": The dynamic self-organization of neural activity into mental shapes*
- 10:00 – 11:00** **KLAAS STEPHAN** - *Model-based inference on mechanisms of maladaptive behaviour and psychiatric disease*
- 11:00 – 11:30** **COFFEE BREAK**
- 11:30 – 12:30** **DEAN BUONOMANO** - *Recurrent Networks, Neural Dynamics, and the Neural Basis of Timing*
- 12:30 – 14:00** **LUNCH**

AFTERNOON SESSION

- 14:00 – 15:00** **DANKO NIKOLIC** - *Time as coding space in neuronal processing*
- 15:00 – 16:00** **ANDREAS DAFFERTSHOFER** - *The influence of amplitude on the connectivity between phases*
- 16:00 – 16:30** **COFFEE BREAK**
- 16:30 – 17:30** **RANDY MCINTOSH** - *Cognition = Networks and noise*

FRIDAY 9/12/2011

Free deliberations and Departure