

## **Distributed model for sensorimotor control: anticipatory coordination and lateral competition**

Jean-Charles Quinton, INRIA/LORIA – CORTEX project

### **Abstract:**

We here propose a two layer modular infrastructure and evaluate various algorithms for competition and spatiotemporal coordination in order to control artificial sensorimotor systems. This research is part of a broader project that aims at understanding the mechanisms and constraints necessary to the emergence of adaptive behaviors from acquired distributed representations. The proposed model takes inspiration from the cerebral cortex organization at a mesoscopic scale, but targets computationally efficient implementations.

The upper layer is composed of distributed spatiotemporal representations, making predictions about the dynamics of the agent and its environment based on the context and actions taken. These anticipations continuously monitor their adequacy with the current sensorimotor flow, which determines their level of activity and influence on the overall dynamics. They are thus task-independent and can be learned in an unsupervised way. They can however flexibly coordinate through a distance based back-propagation of activity between them, as to produce goal-oriented trajectories.

The resulting future-oriented activity is projected on the lower layer, that implements competition between bottom-up and top-down signals. As sensory and motor signals have been unified in the upper layer, this layer not only produces an interpretation of the sensory flow but also dynamically selects the most adequate actions. Although various algorithms have been explored, lateral inhibitory connection schemes are the most promising as they allow attentional properties to emerge and make the system highly robust to noise.

The topology introduced in both layers can be refined by introducing modular maps manipulating only a subset of sensorimotor dimensions, and considering a generalized propagation function between partially specified states. These conceptual extensions are coupled with software and hardware optimization techniques as to provide real-time interaction capabilities.