Neuro-dynamic systems for real-world computation

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Abstract

I present a design concept for intelligent and robust real-world systems focusing on the universal exchangeability of information between different system parts or modules. This leads to consequences including the need for a common representational format (for which I propose a population coding approach), a common system-wide learning algorithm (e.g., simple variant of Hebbian learning) and a flexible fusion and decision making method (for which I suggest dynamic neural fields).

Such neuro-dynamic systems can be used to perform a wide range of cognitive functions. I will present two system instances which support this view by demonstrating robust real-world functionality ([1],[2]). One system performs cue fusion, improving the robustness of an object classifier by combining different feature cues in an adaptive and flexible way. The second presented system implements a short-term memory for high-level features, realizing dynamic binding and disambiguation functionalities. Both systems heavily rely on the competitive properties of neural fields for performing binding, fusion and disambiguation, whereas synaptic plasticity is employed for storing large amounts of acquired knowledge in a systematic and persistent way.

The talk is concluded by an outlook on future investigations, namely using neuro-dynamic systems in autonomous agents, especially in the domain of intelligent vehicles.

Relevant references

[1] Cross-module learning as a first step towards a cognitive system concept. First International Conference on Cognitive Systems, 2008.
[2] A neuro-dynamic memory architecture for short-term feature binding capable of real-world operation. Neural Information Processing Systems (NIPS) 2008, submitted.