Actions in Real-World Situations: Review of Approaches based on Dynamical Systems Theory and Neural Networks

Kevin I. Hynnä, Mathias Creutz and Timo Honkela
Neural Networks Research Center, Helsinki University of Technology
timo.honkela@hut.fi

In traditional AI, models of action have been considered in the context of planning and decision making. It has been commonplace to represent the action directives as rules that determine the actions of an agent. However, in real-world contexts in which the agent receives perceptual input and may have to act in a natural environment, the input data and the low-level action directives are not straightforwardly in symbolic form. This grounding problem has widely been acknowledged as a central problem for symbolic representations. Therefore, a link between the symbolic level and the perceptual or pattern level is needed. In robotics, action is naturally one of the central concepts. Autonomous robots are needed, because with growing complexity of the problems it will no longer be possible for the programmer to take into account all the aspects of the environment in which the system needs to cope.

In this article, we consider implementation of action. We base our study on the following ontological and epistemological assumptions. World is a dynamic continuous process. The continuity is a relevant point of view, for instance, when the linguistic level is considered in which matters are discretized. Cognitive agents perceive and conceptualize the world in categorical form. A mapping between the continuous and multidimensional perceptual andaction domain and the linguistic domain is needed. This mapping resides in the minds (and even brains) but they are formed in a cultural and historical process which involves perception, communication and collaboration, activity, etc. We will discuss the themes presented, e.g., in (Cangelosi and Parisi, 2001), (Feldman and Narayanan, 2003), (Pfeifer and Scheier, 1999), (Port and van Gelder, 1995), and (Honkela and Winter, 2003).

References

Cangelosi, A. and Parisi, D. *Simulating the Evolution of Language.* Springer, 2001.

Feldman, J. and Narayanan, S. (2003). Embodiment in a Neural Theory of Language. *Brain and Language* (accepted for publication).

Honkela, T. and Winter, J. S*imulating Language Learning in Community of Agents Using Self-Organizing Maps*. Helsinki University of Technology, Publications in Computer and Information Science, Report A71.

Pfeifer, R. and Scheier, C. Understanding Intelligence. Bradford, 1999

Port, R. and van Gelder, T. J. (1995) *Mind as Motion: Explorations in the Dynamics of Cognition.* Cambridge MA: MIT Press.

Submission for NCWP9, Plymouth, 8-10 September, 2004