Action in Mind: A Neural Network Approach to Action Recognition and Segmentation

Published (print): Mars, 2018

Category: PhD thesis
Pages: 166

Publication Series: Lund University Cognitive Studies, 172
ISSN: ISSN 1101-8453
URL: ###

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Abstract
Recognizing and categorizing human actions is an important task with applications in various fields such as human-robot interaction, video analysis, surveillance, video retrieval, health care system and entertainment industry.

This thesis presents a novel computational approach for human action recognition through different implementations of multi-layer architectures based on artificial neural networks. Each system level development is designed to solve different aspects of the action recognition problem including online real- time processing, action segmentation and the involvement of objects. The analyses of the experimental results are illustrated and described in six articles. The proposed action recognition architecture of this thesis is composed of several processing layers including a preprocessing layer, an ordered vector representation layer and three layers of neural networks. It utilizes self-organizing neural networks such as Kohonen feature maps and growing grids as the main neural network layers. Thus, the architecture presents a biological plausible approach with certain features such as topographic organization of the neurons, lateral interactions, semi-supervised learning and the ability to represent high dimensional input space in lower dimensional maps.

For each level of development, the system is trained with the input data consisting of consecutive 3D body postures and tested with generalized input data that the system has never met before. The experimental results of different system level developments show that the system performs well with quite high accuracy for recognizing human actions.

Keywords
Action recognition, motion perception, cognitive robotics, hierarchical models, self-organizing neural networks, growing grids, attention.