Title:Perspectives of Robot Action Generalisation: Challenges and Achievements

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Abstract: Making robots more accessible necessitates simplifying their skill acquisition processes. The traditional approach of programmatically specifying each skill that a robot should have is too low level and repetitive to be conveniently used by non expert users. The concept underlying this requirement for higher level communication and teaching is *economy*. Economy in learning is a highly desirable human skill for robots to possess: it can maximise the utility of behaviours already learnt, by reusing them in modified forms, hence minimising the overhead of training new ones.

For robots to achieve this, robust action *generalisation* mechanisms that will allow them to apply a priori knowledge to new, unexpected situations are required. Inspired from human motor control findings, substantial progress has recently been made in creating embodied humanoid robot platforms with advanced motor skills and powerful learning mechanisms. Nevertheless, action generalisation remains a largely implicit research goal, often obscured by the intrinsic difficulties in endowing robots with autonomous and robust motor skills.

To what extent and in which sense can current robots generalise? How complex are the actions they can perform and generalise over? What are the challenges lying ahead and what requirements does generalisation impose on cognitive robotics architectures?

We aim to address these questions through a critical review of the state of the art in robot action learning. Due to the natural link with the concept of learning economy and strong research interest, we focus on L*earning by Demonstration*, but also include hybrid systems that make use of reinforcement learning approaches. We distinguish skill dexterity from action sequence complexity and argue that the interaction between perception and motor control and, more significantly, the hierarchical decomposition of motor control structures into high- and low-level control modules is key for the development of action generalisation skills in cognitive robots.

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