The Cognitive Symmetry Engine

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Abstract

We propose the use of symmetry theories as the basis for the interpretation of sensorimotor data and the creation of more abstract representations. Here we outline a cognitive architecture to implement such an approach and provide a set of specific mechanisms for 1-D, 2-D and 3-D sensorimotor processing. The overall goal is to integrate low-level sensorimotor data analysis and behavior with more abstract affordance representations. Sensorimotor affordance and cognition is an essential capability for self-learning robots. Given only minimal innate knowledge but well-defined sensorimotor cognitive mechanisms, a robot should be able to identify useful relations between its different actuators and sensors. Symmetry plays an important role in identifying invariant sensor-actuator signal relations, and these invariances can be effectively exploited if such relations are bundled for future use. We call these collections of simultaneous symmetries in actuator commands and sensed signals *Symmetry Bundles*. Along with the theoretical framework and semantics of Symmetry Bundles, we define new practical approaches to detect, classify and bundle the inherent symmetries present in signals in order to form useful affordances. The overall cognitive architecture is called the *Cognitive Symmetry Engine*.