Babies and Baby-Humanoids to Study Cognition

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Abstract. Simulating and getting inspiration from biology is certainly not a new endeavor in robotics. However, the use of humanoid robots as tools to study human cognitive skills it is a relatively new area of research which fully acknowledges the importance of embodiment and interaction (with the environment and with others) for the emergence of cognitive as well as motor, perceptual and social abilities.

The aim of this talk is to present our approach to investigating human cognitive abilities by explicitly addressing cognition as a developmental process through which the system becomes progressively more skilled and acquires the ability to understand events, contexts, and actions, initially dealing with immediate situations and increasingly acquiring a predictive capability.

During the talk I will also argue that, within this approach, robotics engineering and neuroscience research are mutually supportive by providing their own individual complementary investigation tools and methods: neuroscience from an "analytic" perspective and robotics from a "synthetic" one. In order to demonstrate the synergy between neuroscience and robotics I will start by briefly reviewing a few aspects of neuroscience and robotics research in the last 30 years to show that the two fields have indeed progressed in parallel even if, until recently, on almost independent tracks. I will then show that since the discovery of visuo-motor neurons our view of how the brain implements perceptual abilities has evolved, from a model where perception was linked to motor control for the only (yet fundamental) purpose of providing feedback signals, toward an integrated view where perception is mediated not only by our sensory inputs but also by out motor abilities. As a consequence the implementation and use of perceptive and complex humanoid robots has become not only a very powerful modeling tool of human behavior (and the underlying brain mechanisms) but also an important source of hypothesis regarding the mechanisms used by the nervous system to control our own actions and to predict the goals of someone elses actions. During the talk I will present results of recent psychophysical investigations in children and human adults as well as artificial implementations in our baby humanoid robot iCub.