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Development and artificial systems: implementing models of development in a humanoid robot.

The study of development, either artificial or biological, can highlight the mechanisms underlying learning and adaptive behavior. We shall argue whether developmental studies might provide a different and potentially interesting perspective either on how to build an artificial adaptive agent, or on understanding how the brain solves sensory, motor, and cognitive tasks. It is our opinion that the acquisition of the proper behavior might indeed be facilitated because within an ecological context, the agent, its adaptive structure and the environment dynamically interact thus constraining the otherwise difficult “learning problem”.

In very general terms we shall describe the proposed approach and supporting biological related facts. In order to further analyze these aspects from the modeling point of view, we shall demonstrate how a twelve degrees of freedom “baby” humanoid robot acquires

orienting and reaching behaviors, and what advantages the proposed framework might offer.

In particular, the experimental setup consists of a robot resembling the human body from the waist up, although with some simplifications. From the sensory point of view, the robot is equipped with two space-variant cameras, an inertial sensor simulating the vestibular system, and proprioceptive information through motor encoders.

The biological parallel is exploited at many implementation levels. It is worth mentioning, for example, the space-variant eyes, exploiting foveal and peripheral vision in a single arrangement, the inertial sensor providing efficient image stabilization (vestibulo-ocular reflex), and the low-stiffness control technique directly borrowed from the Bizzi and Feldman's equilibrium point model.