Intelligent whole-body reaching based on learned internal models

Lorenzo Jamone
Instituto de Sistemas e Robotica, Instituto Superior Tecnico (ISR/IST)
Lisbon, Portugal
ljamone@isr.tecnico.ulisboa.pt

Cognition, perception and postural control for humanoids
Workshop at 2014 IEEE-RAS International Conference on Humanoid Robots
http://www.humanoids2014.com/WS15/

ABSTRACT

I will present some of the results I obtained during the last five years in providing humanoid robots with the ability to learn sensori-motor internal models i) autonomously and ii) incrementally during the goal-directed exploration of the environment. The approach I have been following focuses on some distinctive aspects: life-long continuous learning (accounting for both gradual and abrupt modifications in the system); goal-directed exploration of the environment (i.e. learning a general model by trying to accomplish specific tasks); developmental framework (the acquisition of a motor skill allows to gather new data to learn a new motor skill); bio-inspired (human-inspired) learning and control strategies.
I will sketch a developmental path in which a robot starts from learning how to move the neck [1,2,3] and eyes to fixate and track visual targets and perform arm reaching towards them [5]. During these goal-directed movements the robots builds an internal motor representation of its reachable space [6,7], that eventually can be used to achieve visually-guided locomotion [10] and intelligent whole-body reaching capabilities [12], including the ability to reach with tools [8,9]. Also, the robot will progressively learn about the arm dynamics [13,15] and exploit force and tactile sensing to improve the interaction with the environment [14]. I will also discuss what are the advantages of learning these internal models during goal-directed movements, with respect to random motor babbling [4,11].

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