Co-developmental learning between humanoids and human via force and intentionality interaction

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Abstract. The paper addresses the issue of interactive learning between robots and human tutors. A humanoid robot uses a continuous time recurrent neural network(CTRNN) with a hierarchical structure to learn to predict sensory-motor sequences in object manipulation tasks. Task learning is facilitated through the robot's selftrials, with human guidance, that are repeated in cycles until required tasks are mastered thereby enabling consolidation learning of the neural networks. The human tutor physically guides the robot's hand movements as it attempts the required manipulations. Therefore, force-level interactions between the robot and tutor determine the actual motor trajectories of the robot. Experimental results showed 1) co-developmental shaping of task behaviors stemming from interactions between the robot and tutor, and 2) dynamic structures for articulating and sequencing of behavior primitives that are self-organized in the hierarchically organized network. Hence, a human can successfully tutor a robot if the tutor, while exerting his or her intentions on the robot, can directly experience the intentionality of the robot for task completion.