The Life of *iCub*, A Little Humanoid Robot Learning from Humans through Tactile Sensing

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ABSTRACT

Nowadays, programming by demonstration (PbD) has become an important paradigm for policy learning in robotics [3]. The idea of having robots capable of learning from humans through natural communication means is indeed fascinating. As an extension of the traditional PbD learning scheme, where robots only learn by observing a human teacher, our work follows the recently suggested principle of policy *refinement and reuse* through interactive corrective feedback [1].

However, to be responsive to such feedback, robots must be capable of sensing the world, especially human contact. Our work focuses on the sense of touch. Its integration in robotic applications has many advantages such as: *a)* safer and more natural interactions with objects and humans, *b)* improvement and simplification of the control mechanisms for human-robot interaction and object manipulation [2].

Our video reports on two experimental studies conducted with the *iCub*, a 53 degree of freedom humanoid robot endowed with tactile sensing on its forearms and fingertips. *a)* In a hand-positioning task, the robot is shown how to bring its hand to the location where an object should be grasped. A wrong placement or a wrong approach to the target is corrected by the teacher though a tactile interface [1]. *b)* In a reactive grasping task, the robot is taught how to use its fingertip sensors to adapt and maintain its grasp in the face of external perturbations on the grasped object.

The results of both our experiments show how tactile sensing can be utilized effectively to learn robust control policies through human coaching, by enabling *a)* online policy *refinement* and *reuse*, and *b)* rapid adaptation to external perturbations.

Categories and Subject Descriptors

I.2.6 [**Artficial Intelligence**]: Learning—*knowledge acquisition, parameter learning*; I.2.9 [**Artficial Intelligence**]: Robotics—*manipulators, sensors*

General Terms

Algorithms, Experimentation

Keywords

Tactile sensing, Policy refinement and reuse, Human-robot interaction

Acknowledgments

The research leading to these results has received funding from EC Projects IST-2004-004370 (RobotCub) and IST-04169 (feelix-growing), and from the European Community's Seventh Framework Programme FP7/2007-2013 - Challenge 2 - Cognitive Systems, Interaction, Robotics - under grant agreement n^o [231500]-[ROBOSKIN].

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HRI'11, March 6–9, 2011, Lausanne, Switzerland.
ACM 978-1-4503-0561-7/11/03.