Imitation Learning of Motor Skills

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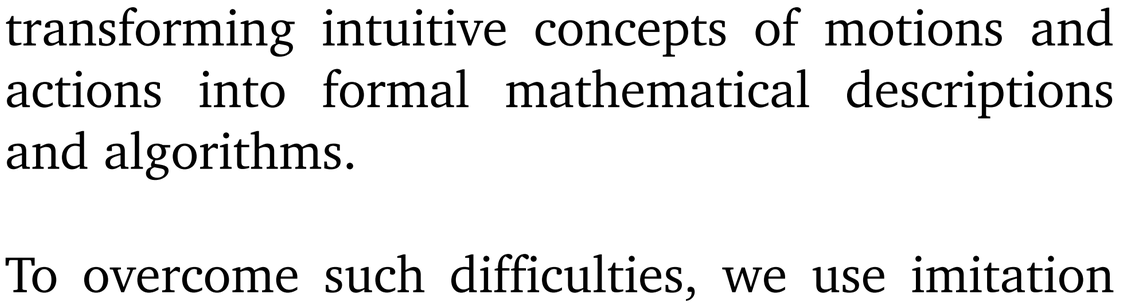
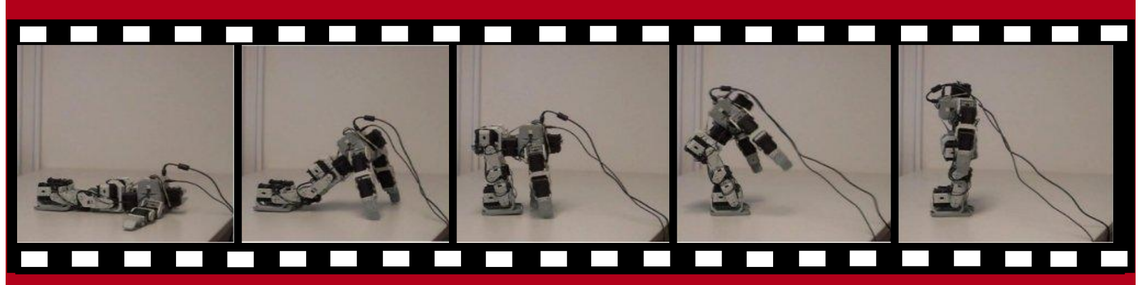
Research in robotics and artificial intelligence has lead to the development of complex robots such as humanoids and androids. In order to be meaningfully applied in human-inhabited environments, robots need to possess a variety of physical abilities and skills. However, programming such skills is a labour- and time intensive task which requires a large amount of expert knowledge. In particular, it often involves transforming intuitive concepts of motions and actions into formal mathematical descriptions and algorithms.

To overcome such difficulties, we use imitation learning to teach robots new motor skills. A human demonstrator first provides one or several examples of the the skill. Information recorded through motion capture or physical interaction is used by the robot to automatically generate a controller that can replicate the seen movements. This is done using modern machine learning techniques.

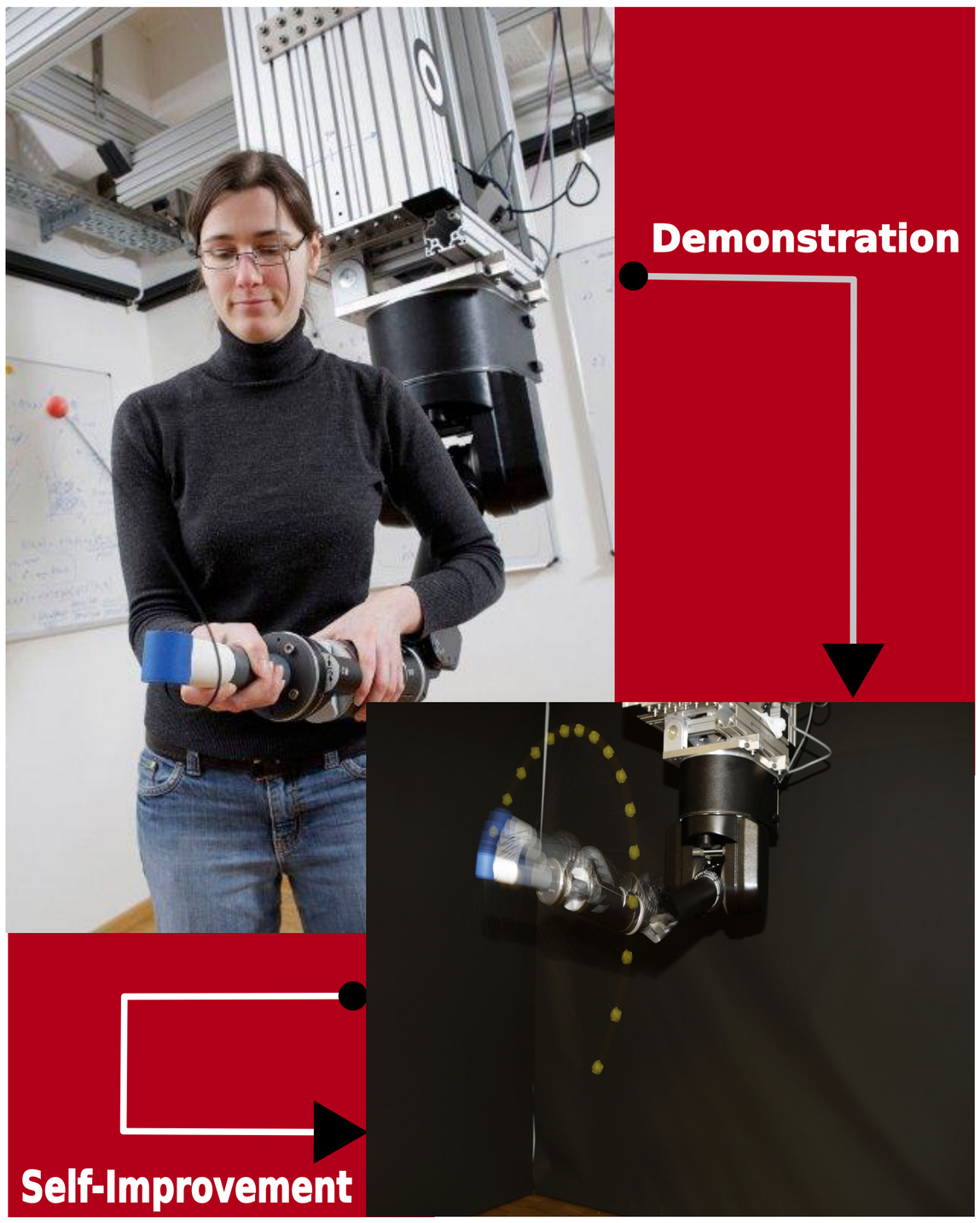


A human teaches a humanoid robot how to stand up.



The robot imitates the demonstrated stand up movement.

Imitation learning also allows robots to improve upon the observed behavior. This so called self-improvement of the task can help the robot to adapt the learned movement to the characteristics of its own body or the requirements of the current context.



Hence, even if the examples presented by the human are not optimal, the robot can still use them to bootstrap his behavior.

At IAS, imitation learning has already been used to teach complex motor skills to various kinds of robots. This includes skills such as locomotion, grasping of novel objects, ping-pong, ball-in-the-cup and tetherball. New machine learning methods that reduce the time needed to acquire a motor skill are developed.

The goal of this research is to have intelligent robots that can autonomously enlarge their repertoire of skills by observing or interacting with human teachers.

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Intelligent Autonomous Systems