

# The HANDLE concepts for grasping and manipulation

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HANDLE is a large-scale integrated project (IP) funded by the European Commission under the ICT thematic area “Cognitive Systems, Interaction, Robotics” of the Seventh Framework Programme (FP7). The project aims at understanding how humans perform the manipulation of objects in order to replicate grasping and skilled in-hand movements with an anthropomorphic artificial hand, and thereby move robot grippers from current best practice towards more autonomous, natural and effective articulated hands. In this talk we will describe the approach and the key concepts involved in the project as well as a summary of techniques employed and the main results obtained during the first year.

The project follows a developmental approach for the acquisition of grasping and manipulation skills. Initial skills are bootstrapped by the observations of humans performing actions on objects. Learning from the human demonstrations allows encoding not only the important sensori-motor trajectories for each action (motor primitives) but also the links to the intended usage of the objects (affordances): objects can be grasped and manipulated in many different ways depending on the task. However, direct replication of the human skills is prone to failures due to mismatches in the sensing and motor abilities between the human data and the robotic devices. In a second phase the robot will fine tune its skills by an autonomous exploration phase. Trial and error interactions with the object allow the optimization of the controllers for the particular physical system in hand. Efficient motor babbling strategies are derived to cope with the high-dimensionality of the sensing and motor degrees of freedom in dexterous humanoid hands. The learnt skills constitute a library of action units that will be combined with on-line planning techniques to cope with the uncertainty of real-world applications.