Abstract, Mila Popovic - Grasping Unknown Objects in an Early Cognitive Vision System

Grasping of unknown objects presents an important and challenging part of robot manipulation. The growing area of service robotics depends upon the ability of robots to autonomously grasp and manipulate a wide range of objects in everyday environments. Simple, non task-specific grasps of unknown objects can also be used in the search-and-rescue scenarios, planetary exploration, or for the handling of the nuclear material. When a robotic system is perceived as a developing cognitive agent, attaining physical control over objects is a precondition for starting a bootstrapping process in which the generic world knowledge is constructed. Creating grasps for unknown objects is difficult because the pose, shape, weight and the material of the object are not known. The objects can be occluded, and the available sensor information is often noisy, containing outliers and incomplete.

This thesis presents a system for robotic grasping of unknown objects using stereo vision. Grasps are defined based on contour and surface information provided by the Early Cognitive Vision System, that organizes visual information into a biologically motivated hierarchical representation. The contributions of the thesis are: the extension of the Early Cognitive Vision representation with a new type of feature hierarchy in the texture domain, the definition and evaluation of contour based grasping methods, the definition and evaluation of surface based grasping methods, the definition of a benchmark for testing and comparing vision-based grasping methods, and the creation of algorithms for bootstrapping a process of acquiring world understanding for artificial cognitive agents.