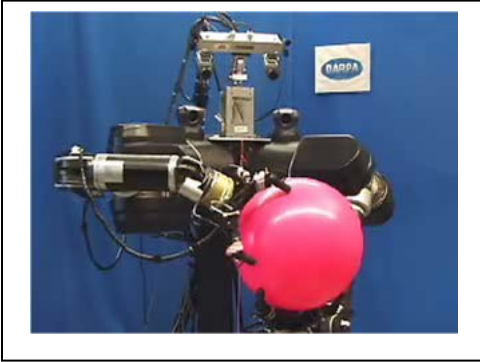


# Learning and Generalizing Control-Based Grasping and Manipulation Skills

Robert Platt, Jr.  
Dexterous Robotic Laboratory  
Johnson Space Center  
NASA

Friday, March 31<sup>st</sup>  
1:30pm  
SEC Plaza A  
(3<sup>rd</sup> floor)



One of the main challenges in the field of robotics is to build machines that can function intelligently in uncontrolled and un-modeled environments. Because of this, the field has witnessed a trend away from the sense-think-act paradigm where the robot makes an attempt to model everything before planning and acting. Nevertheless, few approaches to robotic grasping and manipulation have been proposed that do not require detailed geometric models of the manipulation environment. One exception is the control-based approach where closed-loop controllers reactively generate grasping and manipulation behavior. We develop and extend the control-based approach to grasping and manipulation and propose a new framework for learning control-based skills based on generalized solutions.

This work extends control-based approaches to grasping and manipulation in several ways. First, new approaches to concurrently combining controllers for grasping and displacing grasp contacts are proposed that make control-based grasping faster and more robust. Second, the number of grasps that can be generated using control-based techniques is expanded by using whole body contacts in addition to fingertip contacts. Third, a new approach to statically-stable dexterous manipulation is proposed whereby the robot navigates through a space of statically stable grasp configurations by executing closed-loop controllers.

We also propose a new approach to learning control-based behaviors by applying a generalized solution in new situations. Instead of searching the entire space of all controller sequences and combinations, only variations of a generalized solution, encoded by an action schema, are considered. A new algorithm, known as *schema structured learning*, is proposed that learns how to apply the generalized solution in different problem contexts through a process of trial and error. This approach is experimentally shown to be a practical way to learn grasp skills with little training experience. The learned grasp skills are found to generalize well to new objects and object configurations.

Faculty Host: Andrew H. Fagg ([fagg@ou.edu](mailto:fagg@ou.edu))

*For accommodations on the basis of disability, please call 325-4042  
Refreshments will be served prior to seminar*