Personal robots that help disabled or elderly people in their activities of daily living need to be able to autonomously perform complex manipulation tasks. Traditional approaches to this problem employed task-specific controllers. However, these must to be designed by expert programmers, are focused on a single task, and will perform the task as programmed, not according to the preferences of the user. In this dissertation, we investigate methods that enable an assistive robot to learn to execute tasks as demonstrated by the user. First, we describe a learning from demonstration (LfD) method that learns assistive tasks that need to be adapted to the position and orientation of the user’s head. Then we discuss a recurrent neural network controller that learns to generate movement trajectories for the end-effector of the robot arm to accomplish a task. The input to this controller is the pose of related objects and the current pose of the end-effector itself. Next, we discuss how to extract user preferences from the demonstration using reinforcement learning. Finally, we extend this controller to one that learns to observe images of the environment and generate joint movements for the robot to accomplish a desired task. We discuss several techniques that improve the performance of the controller and help reducing the number of required demonstrations. One of this is multi-task learning: learning multiple tasks simultaneously with the same neural network. Another technique is to make the controller output one joint at a time-step, therefore to condition the prediction of each joint on the previous joints. We evaluate these controllers on a set of manipulation tasks and show that they can learn complex tasks, overcome failure, and attempt a task several times until they succeed.

Major: Computer Science

Educational Career:
Bachelor’s of Computer Engineering, BS, 2011, Sharif University of Technology
Master's of Computer Science, MS, 2014, University of Central Florida

Committee in Charge:
Ladislau Boloni, Chair, Computer Science
Kenneth O. Stanley, University of Central Florida
Peter Hancock, University of Central Florida
GuoJun Qi, University of Central Florida

Approved for distribution by Ladislau Boloni, Committee Chair, on October 17, 2017.

The public is welcome to attend.