Master Thesis Defense Abhishek Padalkar

Date: Friday, 28.02.2020
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Title: Compliant Manipulation with Reinforcement Learning Guided by Task Specification

Abstract:

For effective integration of robots in the working environments along with humans, they need to possess the ability of compliant manipulation. Compliant manipulation can be achieved by modeling the environment and providing an engineered solution for specific tasks. But the limitations on the accuracy of models limit the ability of such approaches. Alternatively, reinforcement learning enables robots to learn compliant manipulation tasks on their own by interacting with the environment. But reinforcement learning needs a huge number of costly robot-environment interactions before learning any meaningful strategy to perform the task. A task can be learned in a simulated environment and then can be transferred to a real robot. In this case, the accuracy of simulation has a very big impact on the transferability of the solution. Furthermore, reinforcement learning can be aided with the task knowledge to minimize the interactions required for learning a particular task. In this master thesis, we designed, implemented and evaluated a compliant manipulation approach using reinforcement learning guided by task frame formalism, which is a task specification method. Developed solution allows us to model easy to model task knowledge using task frame formalism and then learn the unmodeled components in task specification using reinforcement learning. We evaluated the approach by performing two compliant manipulation tasks namely door opening and vegetable cutting with three different robots. Robots were successful in opening doors using task frame formalism alone. Vegetable cutting task was successfully learned with the help of reinforcement learning aided by task frame formalism. We were able to learn force control policy for vegetable cutting task using two different policy representations directly on the robot without using any simulation.